HAZARD/PERRY COUNTY CHAMBER OF COMMERCE

601 Main Street • Suite #3
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July 22, 2003

Department for Surface Mining
#2 Hudson Hollow
Frankfort, Kentucky 40601

To Whom It May Concern:

As President of the Hazard/Perry County Chamber of Commerce and Chairman of the Hazard/Perry County Industrial Board, I would like to include my letter of endorsement in support of mountaintop removal and continued hollow filled mining in Eastern Kentucky. 1-11

The level sites created by mountaintop removal promotes our economy in numerous capacities. These sites can be used for new industry, housing, and various business opportunities, as well as a new golf course. 10-3-5

I would appreciate your consideration in this matter.

Sincerely,

Tony Whitaker,
President/Chairman
Hazard/Perry County
Chamber of Commerce and Industrial Board

January 2, 2004

John Forren
U.S. EPA (3EA30), 1650 Arch Street
Philadelphia, PA 19103

REC'D JAN 0 5 2004

Dear Mr. Forren,

We write on behalf of the 50 undersigned groups, representing millions of Americans, concerning the Draft Programmatic Environmental Impact Statement on Mountain Top Mining/Valley Fill (MTM/VF) in the Appalachian region of the eastern United States. We are extremely troubled over the harmful impacts that mountaintop/valley fill mining has had and could continue to have on a wide array of aquatic and terrestrial organisms. In addition to the direct effects of habitat loss and degradation at mine sites and areas immediately adjacent, the drastic alteration of large landforms over such an extensive region could very well have negative and long-lasting effects on ecosystem processes at considerable distances from the areas more directly disturbed. These concerns are not adequately addressed in the draft EIS. However, despite our serious concerns regarding the potential for disrupting ecological processes and biodiversity in general, these comments are specifically directed to issues regarding migratory birds. The impacts to forest-associated bird species of conservation concern also are not adequately or properly addressed in this draft EIS. 7-3-2

I. The DEIS Ignores the High Priority Assigned through Congress by Wildlife Agencies to the Conservation of Mature Forest Bird Species.

The figures from the draft EIS on cumulative impacts of mining activity in the study area suggest a massive and permanent impact on the entire suite of Partners in Flight priority mature forest birds within the EIS study area (e.g., Cerulean Warbler, Louisiana Waterthrush, Worm-eating Warbler, Kentucky Warbler, Wood Thrush, Yellow-throated Vireo, Acadian Flycatcher) due to a projected loss of over 380,000 acres (149,822 hectares) of high-quality forest to mining in the next ten years. This is in addition to that same amount having been lost in the previous ten years. All of these bird species are also classified as Birds of Conservation Concern by the U. S. Fish and Wildlife Service (USFWS 2002) within the Appalachian Bird Conservation Region, which overlaps the area considered in the draft EIS. This list is mandated by Congress under 1988 amendments to the Fish and Wildlife Conservation Act and denotes species that without additional conservation actions are likely to become candidates for listing under the Endangered Species Act. We consider this level of habitat loss to constitute a significant negative impact for these high priority mature forest birds, and especially for the Cerulean Warbler, the forest species of highest concern in this area. We are struck by the failure of the draft EIS to address this extremely important and significant environmental impact. 8-2-5

While we don't have reliable estimates of the densities of most of these priority species in the region, we do have them for Cerulean Warblers. This is the forest-breeding bird species we are most concerned with because it has suffered drastic population declines over the last several decades and the core of its breeding range coincides very closely with the EIS study area (Figure 1). This species has been petitioned for listing under the Endangered Species Act and is also on the USFWS' National List of Birds of Conservation Concern (USFWS 2002).

II. The DEIS Ignores Available Scientific Data Showing Higher Bird Densities and Higher Potential Losses from Mining Impacts.

Recent research by Drs. Weakland and Wood (2002) at West Virginia University found the average density of Cerulean Warblers territories in intact forest near mined areas in West Virginia was 0.46 pairs/hectare (ha). Assuming each territory provides habitat for a pair of birds, this equates to 0.92 individuals/ha. With the projected loss of over 149,822 ha to future mining in the next ten years, this will result in a loss of 137,836 Cerulean Warblers in the next decade. Dr. Charles Nicholson (TVA 2002) reported a somewhat higher average density of 0.64 pairs of Cerulean Warblers per ha at his study sites within the draft EIS study area in eastern Tennessee. If his density estimate is more representative of the density over the study area, then even more ceruleans would have been impacted in the last decade and the same number would be impacted in the next. Either estimate represents an unacceptable loss.

Partners in Flight (PIF), a science-based initiative dedicated to the conservation of landbirds in the western hemisphere, estimates the global population of Cerulean Warblers, based on relative abundance estimates derived from 1990s Breeding Bird Survey data, to be roughly 560,000 individuals with 80% of the population breeding in the Appalachian region which encompasses the study area (Rich et al. 2004). Applying similar methods, BBS survey data indicate that the average breeding density of Cerulean Warblers across the Northern Cumberland Plateau physiographic area during the 1990s was 0.065 pairs/acre (Rich et al. 2004. Appendix B, Rosenberg and Blancher in press). These numbers indicate that roughly 9% of the world's ceruleans were lost as a result of mining permitted during the 1992 to 2002 period and another 9% will be lost between 2003 and 2012 should the level of mining the draft EIS projects in the next decade come to fruition. In addition, we fear that in a region where Cerulean Warblers presently occur in such high densities, the breeding habitat could already be saturated and the individuals displaced by mines wouldn't be able to find new areas of high-quality breeding habitat to colonize. If this is the case, the reproductive potential of those pairs also will be compromised and the ability of the population to recover will be reduced as a result. It is important to note that these estimates of Cerulean Warbler population loss substantially underestimate the actual impact of mountaintop mining on this species. By definition, mountaintop mining removes forest habitat on mountain and ridge tops. Cerulean Warblers prefer ridgetops within large blocks of mature forest (Weakland and Wood 2002) In addition, Drs. Weakland and Wood (2002) found significantly reduced densities of breeding Cerulean Warblers in forest fragmented by mining and in forest adjacent to mine edges. We find it disturbing and unacceptable that Dr. Weakland and Dr. Wood's research was not included in the draft EIS document when we know that it was made available to those who were involved in its development. 8-2-5

III. The DEIS Fails to Address Technology Changes that will Alter Projections of Future Forest Loss

We believe that the draft EIS projection that an additional 3.4% of forest will be lost between 2002 and 2012 may significantly underestimate the impact of mining on hardwood forests. Not only do these figures fail to include an estimate of the cumulative loss of cove forests from valley fill operations, they also do not take into consideration the anticipated increase in future demand for Appalachian coal due to the planned construction of flue gas desulfurization units (scrubbers) at existing coal-fired generating plants in the study area (TVA 2002). For example, the draft EIS projects that Tennessee will issue permits causing the loss of 9,154 acres of forest in 2003 through 2012, when over 5,000 acres of surface mining permits have already been approved between December 2002 and October 2003 (Siddell 2003). 7-5-3

IV. The DEIS Fails to Identify and Analyze Effective Mitigation Measures to Reduce Bird Losses

The only mitigation offered in the draft EIS for the destruction of large areas of biologically diverse hardwood forest habitat by mining operations is a suggestion that the denuded areas could be reforested after operations cease. While recent research indicates that some forest communities may be reestablished on reclaimed mine sites (Holl et al. 2001), the draft EIS concedes that initiatives to improve the establishment of forests on reclaimed mine sites have only recently begun and "that it would be premature to attempt to evaluate the success of these efforts at this time". In addition, the draft EIS states that "as post-mined sites will likely lack the requirements of slope, aspect and soil moisture needed for cove-hardwood forest communities, it is unlikely that these particular communities can be re-established through reclamation". It will take many decades before these experimental forests mature sufficiently to assess whether they will provide suitable breeding habitat for Cerulean Warblers or any other interior forest-breeding birds of concern. Even if reforestation was determined to be the preferred mitigation for Cerulean Warbler habitat loss, the development of reforestation BMPs (Action 13) would be voluntary and a state or federal legislative change (Action 14) could take years. The suggestion that reforestation is a panacea to mitigate the negative effects of mining on interior forest habitat within the foreseeable future is therefore wrong and misleading. Furthermore, we find it extremely inappropriate that the draft EIS suggests that a mining company could be offered an economic incentive, through the sale of carbon credits, for planting trees to replace the forest that they themselves destroyed during mining activities.

We also find it inappropriate to consider replacing forest habitat with grassland habitat for "rare" eastern grassland species even though these species have declined dramatically as a group in recent decades. Their recovery and habitat restoration efforts should be targeted towards ecosystems and landscapes where they occurred historically, not on eastern mountaintops, where grassland habitat was rare, and currently supports high quality forest habitats. 7-3-3

V. The DEIS Fails to Identify and Analyze Reasonable Alternatives to Avoid Bird Losses

We find the draft EIS' failure to provide an alternative proposal that would provide better regulation of mountain top mining to protect the environment unacceptable and inappropriate. We believe that taken together, these two major flaws are fatal and require the re-issuance of the draft EIS. These fatal flaws mean the draft EIS fails to comply with NEPA. The draft EIS needs to be cured by an EIS that appropriately addresses both the concerns over priority bird species mentioned herein and that offers a solid environmentally sound alternative.

The U.S. Fish and Wildlife Service's September 2002 (USFWS 9/20/02) memo clearly supports our conclusion that the draft EIS is fatally flawed. The FWS warned in the memo that publication of the draft EIS as written, "will further damage the credibility of the agencies involved." That inter-agency memo cites the proposed actions offering "only meager environmental benefits" and criticizes the draft EIS because it did not consider any options that would actually limit the area mined and the streams buried by valley fills. "There is no difference between [the alternatives]," the Fish and Wildlife officials said. "The reader is left wondering what genuine actions, if any, the agencies are actually proposing." The draft EIS erroneously only offers alternatives that would streamline the permitting process for approval of new mountaintop-removal permits. The alternatives, including the preferred alternative, offer no environmental protections and the lack of any such environmentally sound options destroys the NEPA EIS process. 4-2

The FWS memo argued for "at least one alternative to restrict, or otherwise constrain, most valley fills to ephemeral stream reaches...As we have stated repeatedly, it is the service's position that the three 'action' alternatives, as currently written, cannot be interpreted as ensuring any improved environmental protection ... let alone protection that can be quantified or even estimated in advance."

VI. Because the DEIS Is Fatally Defective, It Should Be Revised and Reissued for Public Comment and Permit Issuance Should Cease.

We do not find that the three "action" alternatives offered would improve environmental protection in any measurable way. We propose that a moratorium be placed on new mountaintop mining permits until a new draft EIS is written to provide for the avoidance of key Cerulean Warbler habitat and significant environmental protection for the Louisiana Waterthrush, Worm-eating Warbler, Kentucky Warbler, Wood Thrush, Yellow-throated Vireo, Acadian Flycatcher and other PIF priority species and FWS Birds of Conservation Concern. This moratorium should continue until a final EIS is adopted with an environmentally acceptable alternative.

We believe that NEPA requires such a moratorium as the environmental impacts are so great and the federal government has failed to complete an EIS as required, even after 5 years have passed since litigation was initially filed on this issue. Settlement of the litigation was to result in an EIS and better measures to protect the environment. The draft EIS clearly indicates that this is not occurring. Also, the Clean Water Act dictates individual permits should be required for such major actions and thus, the current use of nationwide permits is illegal. 4-2

We conclude that mining is a short-term benefit to local economies and once the coal is extracted, the industry will leave the region. However, if the scenic vistas and natural heritage of the area are preserved, an economy buoyed by recreation and tourism would provide added value for generations to come. 11-7-2

We appreciate the opportunity to comment on this Draft Environmental Impact Statement.

Respectfully Submitted on Behalf of all the Undersigned Individuals and Organizations,

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Recovery of Native Plant Communities after Mining

Author: Karen D. Holl, Assistant Professor, Department of Environmental Studies, University of California; Carl E. Zipper, Assistant Professor and Extension Specialist, Crop and Soil Environmental Sciences; and James A. Burger, Professor of Forestry, Virginia Tech

Publication Number 460-140, April 2001 Virginia Cooperative Extension

Introduction

Coal surface mining and mine reclamation have had a significant impact on the landscape throughout the Appalachian region, including southwestern Virginia's coalfields. This fact is recognized by the Surface Mining Control and Reclamation Act (SMCRA), which states that mining operations shall establish "a diverse, effective, and permanent vegetative cover of the same seasonal variety and native to the area ... and capable of self-regeneration and plant succession ..." [Section 515(b)19], unless introduced species are necessary to achieve the post-mining land use. Restoring the native hardwood forest is the most direct and comprehensive way of meeting this premise of SMCRA in Appalachian landscapes. Re-establishment of this self-sustaining ecosystem on reclaimed mines can aid in maintaining native wildlife populations while providing other valuable ecosystem services, such as erosion control, carbon sequestration, wood production, water-quality improvement, and watershed protection. Re-establishment of native hardwood-forest ecosystems also contributes to the natural beauty of the Appalachian region.

This publication summarizes research on the impacts of reclamation practices on re-establishment of native Appalachian forest ecosystems, and describes practices that may be used during reclamation to encourage re-establishment of native hardwood forest plant communities.

Appalachian Forest Ecosystems

The mixed mesophytic hardwood forest of the central Appalachians is one of the most diverse temperate ecosystems. These forests served as refuge for moist-forest species during drier glacial epochs and, therefore, are home for a large number of species. The forests often host up to 25 tree species in a given area, along with a diverse understory of ferns, fungi, and herbaceous plants. Common tree species, such as oaks (Quercus spp.), maple (Acer spp.), hickory (Carya spp.), and tulip poplar (Liriodendron tulipifera), not only provide habitat for a wide range of bird, amphibian, and wildlife species, but are also commercially valuable. These forests play an important role in maintaining the water quality in nearby streams including southwest Virginia's Clinch - Powell river system which hosts numerous endemic species of mussels, fish, and crayfish, and is among the most diverse temperate freshwater ecosystems. Large areas of Appalachian forest have been cleared for agriculture and other human uses. Continuous tracts of forest are important for conservation of animal and plant species.

Changing Reclamation Practices over Time:
Prior to SMCRA, mine reclamation practices were variable and often resulted in exposed highwalls, unstable outslopes, and low ground cover. During the earliest surface mining, very little reclamation was performed. Between 1972 and 1977 in Virginia, most mined areas were seeded with grasses, clovers, and black locust (Robinia pseudoacacia); eastern white pine (Pinus strobus) was often planted along the top of the outslope in an effort to disguisehide the exposed highwalls. With the passage of the Surface Mining Control and Reclamation Act (SMCRA) in 1977, reclamation practices were mandated and standardized. SMCRA required that the approximate original contour of the mined area be restored, and that reclaimed areas be seeded with herbaceous vegetation to minimize erosion and to achieve the 90% ground cover after five years. Many post-SMCRA mined areas throughout the Appalachians were reclaimed to hayland - pasture postmining land uses; reclamation practices on these areas included use of aggressive groundcover vegetation such as Kentucky 31 tall fescue (Festuca arundinacea) and sericea lespedeza (Lespedeza cuneata). Many of these areas, however, were not used for production of hay or pasture, allowing natural ecosystem succession processes to take place. During the late 1980s and early 1990s, reclamation of mined areas to unmanaged-forest postmining land use became more common, especially in Virginia. These areas were often seeded with the same aggressive groundcovers that are effective in creating hayland - pasture, such as Kentucky 31 tall fescue and sericea lespedeza. Black locust was often seeded with herbaceous groundcover, and eastern white pine was planted as two-year old seedlings. In the mid- and late-1990s, some mining operators began using less competitive ground covers, as described by Burger and Torbert (1993), and a wider range of planted tree species, including hardwoods, to produce forested areas.

Because success of reclamation is normally judged after five years, reclamation efforts often focus on short-term results and bond release. When the mining is conducted on a pre-SMCRA abandoned mine site, the liability period can be as short as two years. After final bond release, most post-mining lands receive little management and go through succession, the process by which species slowly replace one another as the community develops toward a relatively stable species composition called climax vegetation.

There is an increasing interest in restoring Appalachian forest ecosystems after mining. Yet, there have been few studies monitoring long-term vegetation recovery on coal surface mined lands reclaimed in the Appalachian region using different reclamation practices. Holl surveyed the trees, shrubs, and herbs on 15 reclaimed mine sites and five unmined hardwood sites in Wise County, Virginia, during the summers of 1992-1993 and again in summer 1999 (Holl and Cairns 1994; Holl 2000). A summary of that research is presented below, along with a description of reclamation practices that may be used to aid recovery of the native hardwood forest plant community.

Research Summary

Study Sites
Twenty 0.6-acre plots were surveyed during summer 1992/1993 and summer 1999. These included:

* 5 sites reclaimed 1980-1987
* 5 sites reclaimed 1972-1977
* 5 sites reclaimed 1967-1972
* 5 unmined hardwood forest sites ("reference sites")

The majority of the sites are located on or near the Powell River Project Education Center. The other sites are located near the town of Appalachia. All sites are on steep south-facing slopes, ranging in elevation from 2300 to 3030 ft. Vegetation was sampled in three layers: herb (up to 2.5 feet tall); shrub (2.5 - 8.2 feet tall); and tree (taller than 8.2 feet). Sampling techniques followed those outlined in Holl and Cairns (1994). Cover and number of species were measured in both years and compared.

Summary of Research Results:
Herbaceous layer
In the 1992-93 surveys, herbaceous groundcover was greater than 80% in sites reclaimed after 1972 (Figure 1A). Herbaceous cover dropped substantially between 1992-93 and 1999 on the 1980-87 reclamation sites due to shading by white pine, and on the 1972-77 reclamation sites due to shading by red maple (Acer rubrum), sweet birch (Betula lenta), and other trees. The shift in herbaceous cover to tree cover was interpreted as resulting from the absence or decline of species that compete with small tree seedlings for light and nutrients, such as sericea lespedeza, orchard grass, and Kentucky 31 fescue, and the reduced density of early-successional species such as aster and goldenrod species (Aster spp., Erigeron spp., Hieracium spp., and Solidago spp.). Herbaceous groundcover on the 1967-72 sites was intermediate (about 60%) and changed little between the sampling periods.

During the time period between the two vegetation samples, the number of naturally-colonizing herb species on the 1972-77 and 1980-87 reclamation sites declined, while the number of species growing in the oldest reclaimed sites remained higher (Figure 1B). The decrease in species growing on the 1972-77 and 1980-87 reclamation sites is surprising as species numbers usually increase early in the forest development process. A number of forest herbs such as wild geranium (Geranium maculatum), snakeroot (Sanicula canadensis), and galax (Galax aphylla) are found on the oldest reclaimed sites but not on those reclaimed more recently. The lower number of naturally colonizing herb species on the 1972-77 and the 1980-87 reclaimed mine sites may be due to the more aggressive ground covers commonly planted by mining operators during those periods, and the invasion of sericea lespedeza from other reclaimed mine sites into planted covers. Another possible explanation could be the larger scale of mining, which resulted in increased distances to seed sources.

Trees
The largest increase in tree basal area between sampling periods occurred on the 1980-87 reclamation sites as they were planted primarily with eastern white pine, a fast-growing species (Figure 2A). Tree basal area also increased on the other reclaimed sites due to colonization and growth of hardwood species. The number of tree and shrub species present increased on the most recently reclaimed sites (Figure 2B) with common colonizing species including red maple, sourwood (Oxydendron arboreum), and tulip poplar (Liriodendron tulipifera). Interestingly, the number of woody species on the oldest reclaimed sites remained well below the hardwood sites and did not increase (Figure 2B), raising the question of how long it will take before the full suite of tree species is established.

Overall species composition
A total of 102 native species naturally colonized reclaimed mine sites, indicating that reclaimed mines host a wide diversity of plant species. A full species listing will be made available in the internet version of this publication. Most (75%) of the native tree and shrub species and 65% of the native herbaceous species found in surveys of forest sites were also found on reclaimed mined sites (Tables 1 and 2). Moreover, a large number of herbaceous species, primarily early-successional, were found on reclaimed mine sites but not in the forest. While most common forest species were present on the reclaimed sites, some species, such as the herbs trilium (Trilium grandiflorum), wintergreen (Gaultheria procumbens), and bellwort (Uvularia pudica), and the trees Frasier's magnolia (Magnolia frasieri) and serviceberry (Amelanchier arborea) were not found on any of the reclaimed mines. These species may or may not establish themselves eventually on the mined sites, depending on the extent to which soil properties may have been altered by the mining and reclamation practices.

4

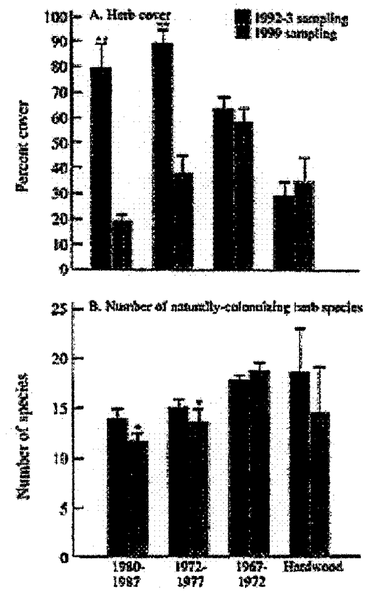

Figure 1. Average herbaceous cover and number of naturally-colonizing herb species.
Error bars = 1 SE. *=p<0.05. **=p<0.01 for comparisons between years.

5

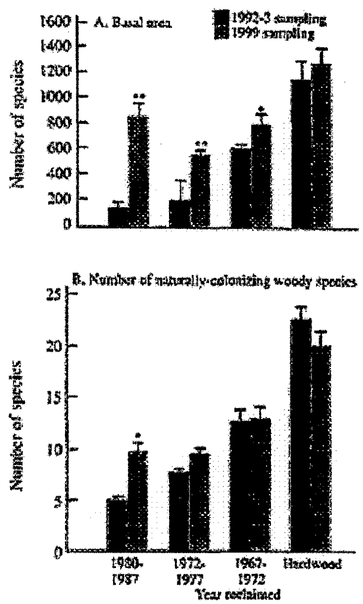

Figure 2. Average herbaceous cover and number of naturally-colonizing tree and shrub species. Error bars = 1 SE. *=p<0.05. **=p<0.01 for comparisons between years.

6

Table 1. -Common species observed on reclaimed and forest sites.

Species/Species Type	Type of Reclamation			
	1980-87	1972-77	1967-72	Forest
Planted				
K-31	X	X		
Sericea lespedeza	X	X		
Red top			X	
Orchard grass	X			
Clover	X	X	X	
Birdsfoot trefoil	X			
Black locust	X	X		
White pine	X			
Understory Herbs				
Goldenrod	X	X	X	X
Heart-leaved aster	X		X	X
Frost aster	X	X	X	
Violets	X	X	X	X
Avens			X	X
Jewel weed		X	X	
Christmas fern	X	X	X	X
Five-fingers	X	X	X	X
Eupatorium	X	X	X	X
Virgin's bower	X	X	X	X
Beggar's tick				X
Understory shrubs				
Laurel	X			X
Blackberry	X	X	X	X
Hydrangea			X	X
Virginia creeper	X	X	X	X
Rhododendron				X
Wild grape	X	X	X	X
Sassafras	X	X	X	X
Dogwood		X	X	X
Overstory				
Chestnut oak				x
Red oak		X	X	X
Wild cherry	X	X	X	X
Tulip poplar	X	X	X	X
Sweet birch	X	X	X	X
Sourwood	X	X	X	X
Hickory		X	X	X
Red maple	X	X	X	X

7

Table 2. -Number of native, unplanted, herbaceous and woody (shrub and tree) species found only on reclaimed sites, forest sites, or both in surveys by Holl (2000) in summer 1992/1993 and 1999.

	Number of native, unplanted species	
Sites where found	**Herbaceous**	**Woody**
Reclaimed only	39	5
Forest only	17	9
Reclaimed and forest	31	27
Total	87	41

Reclamation Practices to Encourage Recovery of Native Forested Ecosystems
The study discussed above is one of a few recent studies documenting long-term forest recovery on reclaimed mine sites in the southeastern United States (Thompson and others 1984; Wade and Thompson 1993; Wade and Tritton 1997; Rodrigue and Burger 2000). These studies clearly show that older reclaimed mine sites host a large percentage of the plant species found in the surrounding forest, and may even host some rare species (Wade and Thompson 1993). Together, these studies show that choice of species used for reclamation appears to influence the plant species naturally colonizing reclaimed mines, as well as the rate at which those species colonize. These results suggest practices that will encourage native forest recovery on reclaimed coal surface mines.

The following procedures are based on the study reviewed above, other research conducted by Virginia Tech researchers sponsored by Powell River Project, and related scientific literature. These procedures can be used to aid rapid re-establishment of forest ecosystems on reclaimed mine areas that are similar in character to native hardwood forests, where such re-establishment is consistent with the post-mining land use objective.

1. Establish a Soil Medium that is Suitable for Forest Species.

In order for mine reforestation to be successful, it is essential that the surface material have chemical and physical properties that are suitable for forest species, that surface materials have sufficient depth for rooting of forest species (at least 4 feet is recommended), and that the material be placed on the surface without excessive compaction by mining machinery such as dozers and haulers.

Prior Powell River Project publications describe these procedures in detail. VCE Publication 460-121 (Daniels and Zipper 1997) reviews general processes and procedures of soil reconstruction. VCE publication 460-123 (Burger and Torbert 1993) provides guidelines for mine reforestation, including soil reconstruction. VCE publication 460-136 (Torbert and others 1996) provides further detail on spoil selection and placement for mine reforestation.

2. Provide Seed Sources for Recolonization by Forest Species.

Given that most species found in the native hardwood forests are not used typically in reclamation plantings, seed dispersal is essential to re-establishment of native hardwood forest plant communities. The majority of the species observed on the older mine sites were not planted by the mining operators, which leads to the conclusion that seeds of many plant species will disperse effectively on reclaimed mines if seed sources are accessible. Mechanisms for seed dispersal include wind, animals, and soil redistribution by the mining process.

Generally speaking, maintenance of native forest close to the reclamation area will encourage recolonization by forest species. On portions of large-area permits that are far-removed from forested areas, plant species that rely on wind or animals for dispersal may not colonize as readily. When possible, retaining native forest to serve as seed sources adjacent to the mining areas, or even as remnants within the mining area where the mining plan allows, will encourage more rapid recolonization. On some re-mining sites, areas enclosed by the permit cannot be mined due to the extent of previous mining; leaving such areas in forest cover with minimal disturbance will encourage recolonization of the mined areas by forest species.

Forest soils harbor many seeds. Use of salvaged soil from the surface of forested areas in reclamation will encourage re-establishment of the forest species. In cases where a nearby area of forest is about to be mined, the soil seed bank might be spread on areas that are in the process of being reclaimed. Wade (1994) found that spreading topsoil from nearby forests on reclaimed mines introduced a large number of species, including 5 tree species, 7 shrubs, 14 grasses, and 53 forbs. In cases where complete topsoil replacement is impractical, use of some topsoil in the reclamation area will provide some seed sources, and more rapid recolonization by forest species than will no re-use of surface soil at all. Whenever possible, topsoil should be moved directly from the mining area to the reclamation area. Topsoil storage prior to respreading will cause seeds to lose viability. The longer the storage period, the greater the loss of seed viability that should be expected.

3. Use Less-Competitive Ground Cover Species

The main reclamation concern of mine operators is meeting SMCRA standards. SMCRA requires operators to plant vegetation that will minimize erosion, and return the land to a productive use. But aggressive grasses and legumes slow or prevent establishment of a number of overstory and understory species characteristic of the native Appalachian hardwood forest. Moreover, extensive research by Burger and Torbert (reviewed in VCE Publication 460-123) shows that certain ground cover species, such as Kentucky-31 tall fescue, sericea lespedeza, and red, white, and sweet clover (Trifolium spp.), hinder establishment of planted seedlings; general observation indicates that these species discourage invasion by woody species "volunteers" from the surrounding forest, as well. It may be that as these ground cover species die back over time more species will colonize these sites, but Holl¼s research demonstrates that planted grasses often provide dense cover for 15 years or more.

Research by Burger and colleagues has demonstrated that less-competitive groundcovers, such as the annual grasses foxtail millet (Setaria italica) and annual rye (Secale cereale), the perennial grasses perennial ryegrass (Lolium perenne) and redtop (Agrostis gigantea), and the legume species kobe lespedeza (Lespedeza striata var. Kobe) and birdsfoot trefoil (Lotus corniculatus) do control erosion effectively, after the first year. The oldest reclaimed sites surveyed, where there is no evidence of having been seeded in sericea lespedeza, hosted the most diverse forest species assemblages. This result suggests that planting with less aggressive species will allow a more rapid recovery of the native ecosystem than what has been observed on sites where reclamation plantings are dominated with aggressive ground cover species. Also, ground cover seeding and nitrogen fertilization rates should be kept low to allow for the colonization of other plant species.

Very little research has been conducted on the capability of groundcover species other than common forages to establish successfully and control erosion on reclaimed mine sites, or on the effect of such species on the rate of forest ecosystem reestablishment. Preliminary research suggests, for example, that some annual wildflower species such as black-eyed Susan (Rudbeckia hirta), cornflower (Centaurea cyanus), and lance-leaved coreopsis (Coreopsis lanceolata) establish when seeded on disturbed sites (Heckman and others 1995). Research on the use of native grasses on disturbed roadsides shows that such species can be established on highway cuts with surface characteristics similar to surface mines, but the timing of seed application and weather conditions during establishment influence seeding success, and erosion control during establishment is a concern (Booze-Daniels and others 1999).

4. Plant a variety of woody species.

In recent years, many mined acres replanted for forest post-mining land use in southwestern Virginia have been planted with a near monoculture of eastern white pine. White pine is widely planted because it is well adapted to acidic soils and grows quickly to meet the 5-year bond release requirement. The rapid biomass accumulation is compatible with timber production as a post-mining land use objective, where markets for white pine are present. However, Holl's research demonstrated that the understory of dense white-pine plantings have very low species diversity, relative to native Appalachian hardwood forests. Herbaceous ground cover in sites planted densely with white pine dropped from 80 to 20 percent over the 1993 - 1999 period as the trees matured.

There is increasing interest in diversifying planted trees because of the commercial value of hardwoods. Such diversification will have beneficial effects on wildlife communities by providing a greater variety of canopy architecture and food sources (Raifall and Vogel 1978; Fowler and Turner 1981) and allowing for establishment of native herbaceous species. For example, bird diversity on reclaimed mines has been shown to be strongly

related to the structural diversity of vegetation (Karr 1968). A number of hardwood tree species that are commercially viable can be used successfully in mine reclamation (Rodrigue and Burger 2000; Torbert and Burger 2000). Although these species may grow more slowly than eastern white pine, they can be expected to provide significant income over the long-term because of the higher value of their wood (Burger and others 1998). A large number of tree species, including many species of oak, pine, and maple, as well as alder, dogwood, and walnut, are available from the Virginia Department of Forestry. Good, reputable tree planters who are familiar with planting hardwoods in viable silvicultural mixtures should be used to help ensure reforestation success.

Conclusion

Under SMCRA, current reclamation practices address short-term concerns required by law, including erosion control, acid mine drainage control where acidic strata are present, and post-mining land use establishment. Maximizing long-term ecological and economic value on these sites requires balancing short- and long-term needs. Research shows that reclaimed mines are capable of supporting forest ecosystems with levels of plant diversity that approach those of natural forests. The research reviewed above showed plant communities on mine sites reclaimed within the past 30 years developed into ecosystems that resemble the native hardwood forests. Although all species in surrounding forests were not found on the mined sites, the reclaimed-mine forests are still very young relative to the native hardwood forests which had developed over much longer time periods.

Research has shown that reclamation practices have a dramatic influence on the rate of forested ecosystem recovery on unmanaged reclaimed mine sites, and on their long-term productivity and economic value. Practices that encourage ecosystem recovery are compatible with and complementary to those that may be used to establish commercially viable, productive hardwood forests on reclaimed mine sites.

Acknowledgments

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Partners In Flight North American Landbird Conservation Plan

September 2003

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Part 1: The Continental Plan

INTRODUCTION

Development of Partners In Flight

Birds are perhaps the most highly valued and actively appreciated component of North America's biological diversity. Approximately 1,200 species, representing nearly 15% of the world's known bird species, inhabit Canada, the United States, and Mexico. Approximately two-thirds of these, including warblers, thrushes, sparrows, finches, hummingbirds, flycatchers, raptors and other groups, occupy principally terrestrial habitats. These "landbirds" are the focus of this document.

Landbirds are an important component of the economy, providing untold billions in dollars of ecosystem services each year. Through their consumption of pest insects, pollination of plants, dispersal of native seeds, and other services, birds contribute to the maintenance of ecosystems that also support human life. Nature-based recreation, a high proportion of which involves observing birds, is the fastest growing segment of the tourism industry, increasing approximately 30% annually since 1987. In 1996 in the U.S. alone, 160 million people (77% of the population) spent $29.2 billion to observe, photograph or feed wildlife.

While birds are valuable to humans in many ways, declines in numerous landbird populations are creating serious concern for their futures. Some species are in sufficient trouble to merit immediate conservation action. Others remain widespread but deserve attention to prevent continued decreases. Because landbird habitats are directly affected by human use of the land, the health of all North American species is in our hands. We therefore have a stewardship responsibility for maintaining healthy populations of still-common species and not simply for preventing extinctions. We must never forget that by far the most abundant bird in North America—the Passenger Pigeon—was driven to extinction from a population size of 3-5 billion in fewer than 100 years (Blockstein 2002).

The causes of population declines in birds are numerous, but the loss, modification, degradation, and fragmentation of habitat almost always play a major role. Threats to habitats come primarily from uncontrolled urban and suburban development and from intensified land-use practices in agricultural and forested regions. Birds are a vital element of every terrestrial habitat in North America. Conserving habitat for birds will therefore contribute to meeting the needs of other wildlife and entire ecosystems.

Recognition that a cooperative, non-adversarial conservation approach was required to address bird and habitat issues at a continental scale led to formation in 1990 of Partners in Flight/Compañeros en Vuelo/Partenaires d'Envol. This voluntary, non-advocacy, international coalition was originally dedicated to reversing declines of Neotropical migratory songbirds, but soon expanded its mission to include all landbirds. Partners include federal, state, provincial and territorial government agencies, non-governmental organizations, numerous universities, concerned individuals, and private industry in Canada, the U.S., Mexico and beyond.

The Partners in Flight mission is expressed through three related concepts:

- *Helping species at risk.* Species exhibiting warning signs today must be conserved before they become imperiled. Allowing species to become threatened or endangered results in long-term and costly recovery efforts whose success often is not guaranteed. Species that have attained endangered or threatened status must not only be protected from extinction, but must be recovered.
- *Keeping common birds common.* Native birds, both resident and migratory, must be retained in healthy numbers throughout their natural ranges. We have a responsibility to be good stewards of species that represent the integrity of North America's diverse and unique ecosystems.
- *Voluntary partnerships for birds, habitats and people.* A central premise of PIF is that the resources of public and private organizations throughout the Americas must be combined, coordinated, and increased in order to achieve success in conserving bird populations in this hemisphere. The power of PIF lies in the synergy that builds when diverse, committed partners who care about birds work together for a common goal.

Each spring, throngs of bird watchers flock to High Island, Texas to observe the songbird migration. During 2001, in the U.S. alone, 66.1 million people (31 percent of the U.S. population) participated in wildlife-watching activities, spending $38.4 billion.

Purpose and Scope of this Plan

Purpose

This Plan provides a continental perspective on North American landbird conservation, presenting geographic, species, and habitat priorities. An international approach is essential because most species breed, migrate, and winter in more than one country, such that Canada, the U.S. and Mexico share many of the same birds at different times of year. Migratory birds are an international resource that requires conservation planning at a continental scale - a different approach than what may be suitable for more sedentary wildlife.

Our audience includes decision-makers, land-managers and scientists at national and international levels, who collectively have the ability to meet PIF's ambitious goals for landbirds.

Based on a comprehensive continental assessment of 448 native landbird species, we establish population objectives and recommended actions for Species of Continental Importance. These objectives and recommendations will facilitate the integration of landbird conservation actions with those described in other continental- and national-scale plans for birds. These include the North American Waterfowl Management Plan (North American Waterfowl Management Plan Committee 1998), Canadian and U.S. Shorebird Conservation Plans (Donaldson et al. 2000, Brown et al. 2001), and Waterbird Conservation for the Americas (Kushlan et al. 2002).

We consider two types of landbirds to be of high conservation importance—those that show some combination of population declines, small ranges, or distinct threats to habitat, and those that are restricted to a major habitat type, but otherwise not at risk. This rationale forms the basis for grouping species into those warranting attention due to concern (i.e., the PIF Watch List), and those that should be recognized as stewardship responsibilities.

What the PIF North American Landbird Conservation Plan does:

- Summarizes the conservation status of landbirds across North America, illustrating broad patterns based on a comprehensive, biologically-based species assessment.
- Identifies species most in need of attention at the continental scale, recognizing that additional species will need attention in each region.
- Emphasizes the important need for stewardship of biome-restricted species that may not otherwise be in need of immediate conservation attention.
- Promotes conservation throughout birds' seasonal cycles, and in all regions of North America—not just during breeding periods or where species at risk occur.
- Presents continental-scale population objectives for species identified as continentally important and identifies general actions necessary to meet those objectives.
- Demonstrates the need for greater resources for landbird conservation.
- Outlines ways in which continental scale issues and objectives relate to regional conservation efforts.
- Promotes a coordinated approach to landbird conservation among nations and regions of North America, which will serve as a stepping stone to even broader geographic cooperation in future.

Although this Plan identifies Species of Continental Importance, we do not advocate species-based conservation as the only, or best, approach to addressing issues. That approach is required in some cases, particularly in protecting endangered species. However, we encourage planners to identify common issues or habitats among suites of high priority species. This enables a more practical approach for implementing conservation actions, which will simultaneously benefit many bird species and other organisms as well.

This Plan is not intended to replace existing or developing regional and state PIF plans. The required conservation and management strategies for several hundred landbird species are far too complex and variable across North America to be treated only at a continental scale. Implementation of on-the-ground bird conservation strategies must take place at state, provincial, and local levels, guided by regional and continental planning. Over the last seven years, PIF has engaged in a comprehensive planning effort, resulting in several dozen regional bird conservation plans covering all states or physiographic areas in the U.S. (Pashley et al. 2000, www.PartnersInFlight.org). Similar regional efforts are underway in Canada and Mexico. These regional and state PIF plans (Appendix C) identify priority species and habitats, set goals and objectives, discuss local issues and opportunities, and outline strategies for local or regional partners to implement bird conservation objectives. Part II of this Plan summarizes the salient issues faced by North American landbirds, reflecting the recurring messages of the regional plans.

Scope

Geographic

For the purposes of this document, "North America" includes Canada, the continental U.S., and Mexico. However, this version of the Plan is limited to landbirds that regularly breed in the continental U.S. and Canada. Nonetheless, Mexican scientists provided important ideas and strategies for this plan as well as considerable data on the status in Mexico of many species included here.

Under the guidance of the Mexican National NABCI Committee, a working group was established in 2002 to develop the species assessment process for all bird species present in that country (approximately 1,100 species). Mexico is following the PIF methodology, and the first conservation status assessment for all Mexican species is expected by the end of 2003. Thus, we are preparing for a smooth integration of about 450 Mexican landbird species in future iterations of this Plan. Species assessment also has taken place for portions of the Caribbean, and partners are coordinating bird

The PIF Continental Plan considers 448 landbird species native to the United States and Canada from the following 45 families. Colored text shows additional families with landbirds native to Mexico that will be treated in future versions of the Plan.

Family	Taxa	Family	Taxa
Tinamidae	Tinamous	Pipridae	Manakins
Cathartidae	Vultures	Laniidae	Shrikes
Accipitridae	Hawks, Eagles & allies	Vireonidae	Vireos & Greenlets
Falconidae	Falcons & Caracaras	Corvidae	Jays, Crows & allies
Cracidae	Chachalacas & allies	Alaudidae	Horned Lark
Phasianidae	Pheasants, Grouse, Turkeys	Hirundinidae	Swallows
Odontophoridae	Quail & allies	Paridae	Chickadees & Titmice
Columbidae	Doves & Pigeons	Remizidae	Verdin
Psittacidae	Parrots & Parakeets	Aegithalidae	Bushtit
Cuculidae	Cuckoos & Anis	Sittidae	Nuthatches
Tytonidae	Barn Owls	Certhiidae	Brown Creeper
Strigidae	True Owls	Troglodytidae	Wrens
Caprimulgidae	Nightjars	Cinclidae	American Dipper
Nyctibiidae	Potoos	Regulidae	Kinglets
Apodidae	Swifts	Sylviidae	Arctic Warbler, Gnatcatchers & allies
Trochilidae	Hummingbirds	Turdidae	Thrushes
Trogonidae	Trogons & Quetzals	Timaliidae	Wrentit
Momotidae	Motmots	Mimidae	Mockingbirds, Thrashers & Catbirds
Alcedinidae	Kingfishers	Motacillidae	Wagtails & Pipits
Bucconidae	Puffbirds	Bombycillidae	Waxwings
Galbulidae	Jacamars	Ptilogonatidae	Silky Flycatchers
Ramphastidae	Barbets & Toucans	Peucedramidae	Olive Warbler
Picidae	Woodpeckers & allies	Parulidae	Wood Warblers
Furnariidae	Spinetails, Leaftossers & allies	Coerebidae	Bananaquit
Dendrocolaptidae	Woodcreepers	Thraupidae	Tanagers, Euphonias & allies
Thamnophilidae	Antshrikes, Antwrens, Antbirds & allies	Emberizidae	Towhees, Sparrows, Seedeaters & allies
Formicariidae	Antthrushes & Antpittas	Cardinalidae	Saltators, Grosbeaks, Buntings & allies
Tyrannidae	Flycatchers, Becards, & Tityras	Icteridae	Blackbirds, Orioles & allies
Cotingidae	Cotingas	Fringillidae	Finches

Appendix A. Assessment scores and estimated population size of North American landbirds - continued

Common Name	Scientific Name	PS	BD	ND	TB	TN	PT	Combined Score	Est. Global Population	% Population in US & Canada	Monitoring Need
Palm Warbler	*Dendroica palmarum*	2	2	3	2	2	1	8	23,000,000	100%	Mo3
Bay-breasted Warbler	*Dendroica castanea*	3	3	4	3	3	4	14	3,100,000	100%	Mo3
Blackpoll Warbler	*Dendroica striata*	2	2	4	3	2	3	12	21,000,000	100%	Mo3
Cerulean Warbler	*Dendroica cerulea*	3	4	4	4	4	5	16	560,000	100%	
Black-and-white Warbler	*Mniotilta varia*	2	2	2	2	2	3	9	14,000,000	100%	
American Redstart	*Setophaga ruticilla*	2	1	2	2	2	2	8	25,000,000	100%	Mo3
Prothonotary Warbler	*Protonotaria citrea*	3	3	4	3	4	4	15	1,800,000	100%	
Worm-eating Warbler	*Helmitheros vermivorus*	3	3	4	3	4	3	14	790,000	100%	
Swainson's Warbler	*Limnothlypis swainsonii*	4	4	5	4	4	1	14	84,000	100%	
Ovenbird	*Seiurus aurocapillus*	2	2	3	2	3	2	10	24,000,000	100%	
Northern Waterthrush	*Seiurus noveboracensis*	2	1	2	2	2	3	9	13,000,000	100%	Mo3
Louisiana Waterthrush	*Seiurus motacilla*	4	2	3	3	4	2	13	260,000	100%	
Kentucky Warbler	*Oporornis formosus*	3	3	4	3	3	4	14	1,100,000	100%	
Connecticut Warbler	*Oporornis agilis*	3	3	3	3	2	4	13	1,200,000	100%	Mo3
Mourning Warbler	*Oporornis philadelphia*	2	3	3	2	2	4	11	7,000,000	100%	Mo3
MacGillivray's Warbler	*Oporornis tolmiei*	2	3	3	2	2	3	10	5,400,000	99%	
Common Yellowthroat	*Geothlypis trichas*	2	1	2	2	2	2	8	32,000,000	100%	
Hooded Warbler	*Wilsonia citrina*	3	2	4	3	3	3	13	4,000,000	100%	
Wilson's Warbler	*Wilsonia pusilla*	2	1	3	3	2	4	12	36,000,000	100%	Mo3
Canada Warbler	*Wilsonia canadensis*	3	2	3	3	4	4	14	1,400,000	100%	Mo3
Red-faced Warbler	*Cardellina rubrifrons*	4	5	5	3	3	3	15	430,000	25%	Mo1
Painted Redstart	*Myioborus pictus*	3	3	4	3	3	3	13	0.5 - 5,000,000	< 5%	Mo1
Rufous-capped Warbler	*Basileuterus rufifrons*	3	3	3	2	2	3	11	0.5 - 5,000,000	< 1%	Mo1
Yellow-breasted Chat	*Icteria virens*	2	1	3	3	2	2	10	12,000,000	67%	
Hepatic Tanager	*Piranga flava*	4	1	1	3	3	2	10	360,000	25%	
Summer Tanager	*Piranga rubra*	3	2	2	3	2	2	10	4,100,000	80%	
Scarlet Tanager	*Piranga olivacea*	3	2	4	2	3	2	12	2,200,000	100%	
Western Tanager	*Piranga ludoviciana*	2	2	3	2	2	2	9	8,900,000	99%	
Flame-colored Tanager	*Piranga bidentata*	3	4	4	3	3	3	13	0.5 - 5,000,000	< 1%	Mo1
White-collared Seedeater	*Sporophila torqueola*	2	3	3	2	1	3	10	5 - 50,000,000	< 1%	Mo1
Olive Sparrow	*Arremonops rufivirgatus*	3	4	4	3	3	2	12	2,100,000	10%	Mo2
Green-tailed Towhee	*Pipilo chlorurus*	3	3	3	3	2	3	12	4,100,000	100%	
Spotted Towhee	*Pipilo maculatus*	2	2	2	2	2	2	8	14,000,000	90%	
Eastern Towhee	*Pipilo erythrophthalmus*	2	2	2	3	2	4	11	11,000,000	100%	
California Towhee	*Pipilo crissalis*	3	4	4	2	2	3	12	4,700,000	50%	
Canyon Towhee	*Pipilo fuscus*	2	3	3	2	2	2	9	6,500,000	25%	
Abert's Towhee	*Pipilo aberti*	4	5	5	3	3	3	15	230,000	90%	
Bachman's Sparrow	*Aimophila aestivalis*	4	4	4	4	4	5	17	250,000	100%	
Botteri's Sparrow	*Aimophila botterii*	3	4	4	3	2	3	13	0.5 - 5,000,000	< 5%	Mo1
Cassin's Sparrow	*Aimophila cassinii*	2	3	4	3	3	4	13	20,000,000	50%	
Rufous-winged Sparrow	*Aimophila carpalis*	4	5	5	3	3	3	15	74,000	12%	Mo1
Rufous-crowned Sparrow	*Aimophila ruficeps*	3	3	3	2	2	4	12	2,400,000	50%	
Five-striped Sparrow	*Aimophila quinquestriata*	4	5	5	3	3	4	16	50 - 500,000	< 1%	Mo1
American Tree Sparrow	*Spizella arborea*	2	2	2	2	2	4	10	26,000,000	100%	Mo3
Chipping Sparrow	*Spizella passerina*	1	1	2	1	2	2	7	99,000,000	90%	
Clay-colored Sparrow	*Spizella pallida*	2	2	3	2	2	4	11	23,000,000	100%	Mo3
Brewer's Sparrow	*Spizella breweri*	2	3	3	3	2	5	13	16,000,000	100%	
Field Sparrow	*Spizella pusilla*	2	2	2	3	2	5	12	8,200,000	100%	
Black-chinned Sparrow	*Spizella atrogularis*	4	3	4	3	3	4	15	390,000	80%	
Vesper Sparrow	*Pooecetes gramineus*	2	1	2	3	2	4	11	30,000,000	100%	
Lark Sparrow	*Chondestes grammacus*	2	1	3	2	2	5	12	9,900,000	89%	
Black-throated Sparrow	*Amphispiza bilineata*	2	3	3	2	2	5	12	27,000,000	50%	
Sage Sparrow	*Amphispiza belli*	3	3	4	4	3	2	13	4,300,000	90%	
Lark Bunting	*Calamospiza melanocorys*	2	3	3	3	3	4	12	27,000,000	100%	

APPENDIX B. METHODS USED TO ESTIMATE POPULATION SIZES AND PERCENTS

Estimates of global population size were needed for each species of landbird covered by this Plan for several reasons:

- To score the Population Size factor (PS) in our species assessment. For this purpose, we needed order of magnitude resolution on population sizes, using to the extent possible a single methodology to give comparable estimates across all species;
- To provide estimates of "current" population size for each landbird species. This gives an impression of the size of the landbird resource, and more importantly it emphasizes the magnitude of the task of attaining listed population objectives;
- To provide a starting point for estimating population sizes in each Bird Conservation Region, and an understanding of the magnitude of attaining objectives regionally. We emphasize that additional work to check and refine estimates in each region is highly desirable, because additional population data may be available, different analytical methods may provide more precision at the regional scale, and because assumptions applied at the continental level may need to be revisited within each region.

Population size estimates for the U.S. and Canada south of the arctic:

We used Breeding Bird Survey (BBS) data from the 1990s as the basis for population estimates across the U.S. and across Canada south of the arctic (i.e., excluding Bird Conservation Region [BCR] 3, see next section). BBS-based estimates of abundance were calculated according to the following steps:

1) For each BBS route run within acceptable weather conditions, counts were averaged across years to give a single average count for the 1990s for each species recorded on each route.

2) In the boreal forest portions of Canada, where BBS routes are widely scattered, routes not run during the 1990s were added to augment geographical coverage, using data from other decades for these routes (boreal routes that were run during the 1990s still provided the bulk of boreal count data, and species counts from those routes were restricted to the 1990s).

3) Species counts were averaged across all BBS routes in each geo-political polygon defined by the intersection of a BCR and a province/state/territory – for example, separate averages were calculated for each of the three U.S. states and three Canadian provinces that together comprise the Boreal Hardwood Transition (BCR 12).

4) Where a geo-political polygon was not sampled by BBS routes, we assigned averages from adjacent polygon(s) in the same BCR. In the U.S., unsampled polygons were typically smaller than 1,000 km2, so this procedure had minimal effect on continental population estimates. In boreal Canada, unsampled polygons were sometimes large (exceeding 100,000 km2 in two instances) so that population estimates for boreal BCRs are less likely to be representative of the whole region.

5) Indices of abundance were calculated for each geo-political polygon by multiplying average counts per BBS route (from step 4) times area of the geo-political polygon, and dividing by the theoretical area covered by a BBS route (25.1 km2, assuming 400-m radius around each of the 50 count circles). For example, the index of abundance for Wood Thrushes in the Ontario portion of BCR 12 equals 2.33 birds/route (55 routes sampled in 1990s) x 202,860 km2 (area of Ontario in BCR 12) / 25.1 km2 (area per BBS route) equals approximately 19,000.

6) BCR-wide indices of abundance were calculated by simple addition across all polygons making up each BCR, thus giving a population index for Wood Thrushes in all of BCR 12 of approximately 40,000. State and province-wide indices of abundance can be calculated in the same manner.

7) BCR-wide population indices were converted to population estimates by applying three correction factors (see Rosenberg and Blancher, in press, for more detail on these correction factors):

Pair correction: Indices were multiplied by two on the assumption that typically a single member of a breeding pair is observed during BBS tallies;

Detection area correction: Most species are not detected out to the full 400m BBS count circle. Each species was placed into one of five detection distance categories, based on presumed effective detection during 3-minute BBS counts: 80m, 125m, 200m, 400m and 800m. Because area of detection increases as the square of detection distance, the detection area correction is then simply the square of the ratio between 400m (theoretical BBS count circle) and species-specific effective distance. For example for Wood Thrush, placed in the 200m class, the population index is multiplied by a detection area correction of 4 (square of 400/200). Note that effective detection distances are intended to incorporate not only the distance at which a species is normally heard and seen, but also the radius of its movement during a 3-min count period – this is why some wide-ranging species have been assigned an 800-m detection distance despite being counted within a 400-m BBS circle.

Time of day correction: Almost all species show a temporal change in detection across the 50 BBS stops, some declining from a dawn chorus, others peaking after sunrise or later in the morning. A time of day correction is applied to the population index to adjust counts to the maximum time of detection. This adjusts for birds not detected at other times of the morning. The correction factor is the ratio of counts at the peak of detection (calculated using a polynomial curve fit to smooth out stop-by-stop variance) relative to the average count over whole BBS routes. Time of day correction factors were calculated from survey-wide BBS stop-by-stop data. For Wood Thrush, whose detectability declines from a peak at BBS stop 1, the time of day correction is 2.30.

For Wood Thrushes, the population estimate for BCR 12 = 40,000 (index from step 6) x 2 (pair correction) x 4 (detection area correction) x 2.30 (time of day correction) = approximately 740,000 breeding individuals.

Population size estimates for arctic Canada (BCR 3):

In the absence of BBS data, we used a combination of Breeding Bird Census (BBC) density estimates (Kennedy et al. 1999) and relative abundance data from the *Northwest Territories / Nunavut Bird Checklist Survey* <http://www.mb.ec.gc.ca/nature/migratorybirds/nwtbcs/index.en.html> to estimate population size of landbirds in the arctic (BCR 3) portion of Canada, as follows:

1) Total landbird density was calculated from BBC data for each of three terrestrial ecozones that make up BCR 3 in Canada (Arctic Cordillera, Northern Arctic and Southern Arctic).

2) Total landbird density was split among three classes of landbirds – those likely to be detected at long distances (raptors, ravens), those at intermediate distances (birds of open country) and the rest (birds of woods and scrub).

3) Relative abundance of each landbird species was calculated from Checklist data for each of the ecozones and classes of birds above. Checklist data were first screened to remove lists in which all bird species were not recorded, or the observer self-identified as "fair" at species identification, or month was not June or July. Counts per species were averaged across years within sites before further analysis.

4) The ratio of BBC density to checklist abundance (density conversion factor) was calculated for each ecozone and class of landbird. The two northern ecozones were collapsed into one due to lack of difference in conversion factors.

5) Density conversion factors were applied to checklist abundance data to provide density estimates of each landbird species at 649 sites across the arctic (those in BCR 3 in Canada).

6) Bird densities from checklist sites were averaged within each of 30 Arctic ecoregions, then multiplied by size of region to convert to a population estimate for that ecoregion. Estimates for unsampled ecoregions were derived as area-weighted averages from all sampled ecoregions in the same terrestrial ecozone. Population estimates were then summed across ecoregions to provide a total population estimate for each landbird species in the arctic.

Estimating global populations:

For species breeding entirely within the U.S. and Canada, our estimate of global population size was a simple sum of the above two estimates (BBS-based estimate plus arctic Canada estimate).

For species with broader breeding distributions, but still at least 10% of range in the U.S. and Canada, we extrapolated global population size on the basis of proportion of breeding range outside of the U.S. and Canada. Proportions of breeding range were estimated from range maps.

For species with more than 90% of breeding range outside the U.S. and Canada, we estimated global population size to order of magnitude (as for PS scores) based on range size and a comparison to population sizes of other landbird species that were judged to have similar relative abundance.

Exceptions to the methods presented above:

We accepted independent estimates of population size for some landbird species that have been surveyed by other methods more appropriate and specific to the species, for which continental-scale estimates were available or could be estimated at a level of accuracy deemed to be superior to our standard estimates.

Some assumptions in estimating population sizes:

For a variety of reasons, the population estimates presented here are rough estimates, and will need to be improved over time, especially for use at smaller scales. Without attempting to be comprehensive, a few main assumptions of the approach are mentioned here (see Rosenberg and Blancher, in press).

Habitats are sampled in proportion to their occurrence in the regional landscape: Although BBS is designed to provide a random sample of the landscape, limitations of a road-based survey mean that the landscape sampled is a biased representation of available habitat – for example species characteristic of high elevation habitats are likely to be undersampled by BBS simply because roads tend to follow valley bottoms in mountainous regions. In northern BCRs, there is a geographic bias, with most BBS data available from the southern portions of those BCRs. Checklist and Breeding Bird Census sites are determined by individual scientists and volunteers, so are not a random sample of arctic regions. We have not accounted for habitat bias in our continental estimates, in part because it will differ from region to region, and because the magnitude of bias has not yet been estimated in many regions or at a continental scale. Correction for habitat bias should be considered when using the methods described above at smaller scales.

Birds present but not detected during BBS counts are accounted for by one or more of the three density corrections applied above (pair, detection area, and time of day corrections): Species that have a peak of detection outside of the BBS sampling window (e.g., early-season breeders, most nocturnal species) are likely to have been underestimated. Pair corrections may result in over-estimation of population size, if a high proportion of counts involve either both members of a pair, or unmated birds.

Checklist / BBC-derived estimates from arctic Canada are comparable to BBS estimates: There are no BBS data from BCR3 in Canada to test this assumption. However, checklist/BBC-derived landbird density was 79 birds/km2 in the Canadian arctic, versus a BBS-derived 127 birds/km2 in the BCR 3 portion of Alaska. This difference is in the expected direction, because the Canadian arctic has a larger proportion of High Arctic where landbird density is typically low.

Breeding density within the U.S. and Canada is similar to density elsewhere in the breeding range: Extrapolation of population size estimates to global population rely on this assumption, though it does not affect U.S./Canada population estimates, nor population objectives for the U.S. and Canada.

How accurate are the population estimates?:

Measures of precision for population estimates are not presented in this Plan. Although we have measured variance associated with some of the parameters, others have yet to be estimated. Conversion of BBS relative abundance to estimated density depends on several adjustment factors, each of which carries associated variance. A high proportion of undetected birds, habitat bias and incorrect assignment of detection distance category have potential for large effects on estimates. Nevertheless, comparison with atlas-derived population estimates suggests that population sizes are still well within the correct order of magnitude for landbirds regularly encountered on BBS routes (Rosenberg and Blancher, in press). Additional comparisons will be useful for refining the estimates and independent estimates are sought for all species.

Estimates of percent of global population:

Estimates of the percent of global population within BCRs and biomes were needed to assign BCRs to Avifaunal Biomes, to identify Stewardship Species in those biomes, to construct maps weighted by proportion of population in Avifaunal Biomes, and to provide an indication of degree of regional responsibility for Watch List and other species.

Breeding season
For the breeding season, estimates of proportion of global population were calculated by dividing regional population estimates by global population estimates.

Winter percents
For resident species, we assumed percent of global population was the same as in the breeding season. For migratory species, we based our estimates for the U.S. and Canada on Christmas Bird Count (CBC) data, calculated as follows:

1) For each CBC count circle surveyed between 1990/91 and 1997/98, birds observed per 100 party-hrs were calculated and then averaged across years to give a single effort-adjusted count per species per

count circle.

2) Effort-adjusted counts were averaged across all CBC count circles in each geo-political polygon defined by the intersection of a BCR and a province / state / territory. These average effort-adjusted counts were then multiplied by area of the geo-political polygon to yield an abundance index for each species in the polygon.

3) Abundance indices were summed across polygons within BCRs to give an abundance index for each BCR. Where a geo-political polygon was not sampled by CBC sites, an area-weighted average from other polygons in the same BCR was assigned. Most geo-political polygons without CBC count circles were in the boreal forest or arctic, where relatively few landbird species spend the winter.

4) Percent of U.S. and Canada winter population was then calculated for each BCR by dividing BCR abundance indices (from step 3) by the sum of all BCR indices across the U.S. and Canada.

5) Percent of global winter population was estimated in the same manner as summer population estimates, using proportion of winter range to estimate proportion of global range in the U.S. and Canada.

Some assumptions in estimating percent of population:

Habitat bias is consistent across the survey area: Because estimates of percent are relative measures, they are much less affected by habitat bias and density corrections than are population estimates, as long as biases are relatively consistent across the survey area. Thus percent of population based on CBC circles can be reasonably accurate despite strong potential for bias in the non-random placement of circles.

Differences in effort among CBC counts can be standardized by dividing by party-hour: In fact, species will respond differently to different types of effort (party-hour, party-mile, feeder counts, nocturnal effort). Also, response to increasing effort is likely to be non-linear, eventually becoming asymptotic. However, estimates of percent of winter population by BCR or avifaunal biome were relatively insensitive to these issues. Comparison of percents of winter population were similar whether calculated without any effort correction, correcting with party-miles, or using party-hours to correct effort. Only for a few northern species were there important differences depending on which method of error correction was used.

AN ATLAS OF CERULEAN WARBLER POPULATIONS

Final Report to USFWS: 1997–2000 Breeding Seasons

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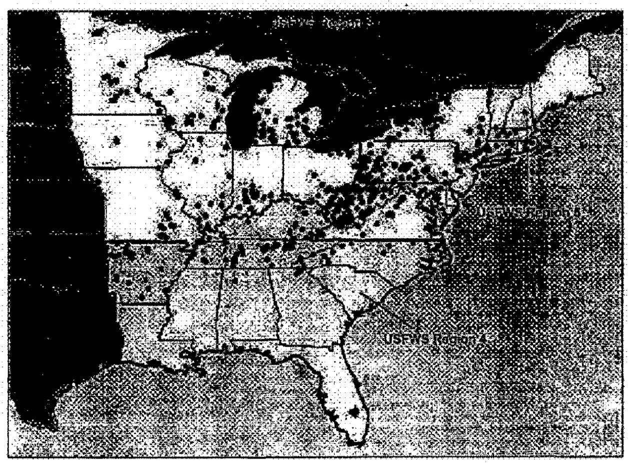
December, 2000

CEWAP populations throughout the Cerulean Warbler's range, 1997–2000



Map 1. Cerulean Warbler populations, as documented by CEWAP, in USFWS regions 3, 4, and 5.

Contents

INTRODUCTION

The Cerulean Warbler Atlas Project (CEWAP) was a four-year study designed to determine the population status, habitat, and area requirements of Cerulean Warblers (*Dendroica cerulea*), a high-priority Neotropical migratory bird, within USFWS Regions 3, 4, and 5. This study employed volunteer birders as well as professional biologists, and was administered through the Partners in Flight (PIF) regional and state working groups, USFWS contacts, and the Cornell Lab of Ornithology's network of citizen-scientists. This CEWAP Final Report summarizes and reports data submitted by each participating state and region from the 1997 to 2000 breeding seasons.

Need For Project

The Cerulean Warbler is among the highest priority landbirds for conservation in the United States. It ranks as extremely high priority on the national Watchlist based on Partners in Flight prioritization scores, and it ranks second in terms of immediate conservation concern in the PIF Northeast region (Rosenberg and Wells 1995, 2000). These priority rankings are based on a small total population size and a significant declining Breeding Bird Survey (BBS) trend throughout its range (-4.2% per year since 1966). Cerulean Warblers are declining across much of their North American breeding range and are now listed as a species of concern in 13 states, threatened in 2 states, and endangered in 1 state. They are also federally listed as "vulnerable" in Canada. In portions of the Northeast, however, Cerulean Warblers are thought to be expanding their range and population size. In the Midwest and Southeast—as well as areas in the Northeast such as New England, New York and New Jersey—this species is not adequately sampled by the BBS because of low overall density. Therefore, its distribution in these areas remains poorly known and accurate population trends have not been estimated.

Because of severe declines throughout the Cerulean's range, the USFWS has recently completed a Status Assessment of Cerulean Warblers (Hamel 2000), for possible listing under the Endangered Species Act. Hamel (2000) provides a compilation of historical records and contemporary anecdotes about the status of this bird; however, the report is limited by the lack of recent published information on this species from most states. In particular, conservation planning for regional populations is hampered by poor knowledge of present-day breeding locations, as well as by a lack of local data regarding habitat affinities, area requirements, or threats. In October 2000, a petition was filed to list the Cerulean Warbler as federally threatened. In light of the Status Assessment and the petition, updated data concerning the Cerulean's status, population numbers, and critical breeding sites are of utmost importance. CEWAP attempted to fill these knowledge gaps by coordinating the efforts of professional biologists and experienced birders through a simple protocol designed to survey and study Cerulean Warblers throughout each region.

Project Goals

The original goals of CEWAP, as stated in the Scope of Work to the USFWS, were as follows:

- Identify important populations of Cerulean Warblers in each state, and determine the status of these populations—how many pairs? Are they reproducing successfully? Are there local threats to the population? Are populations expanding or declining?
- Determine the range of acceptable habitats and area requirements in each region—measure habitat structure, landscape characteristics of sites, nest-site characteristics, estimate densities in different forest-types, attempt to estimate productivity.
- Identify suites of bird and plant species associated with Cerulean Warblers
- Set population and habitat goals for the Northeast region and sub-region units, as part of the regional PIF planning process
- Produce a "how-to" manual of habitat management strategies for areas having (or potentially supporting) Cerulean Warblers

This atlas of Cerulean Warbler populations addresses the first portion of these ambitious goals. In this report we identify specific locations of present-day breeding populations in each region and state and attempt to estimate population sizes based on data collected by over 200 field collaborators. We also provide summaries of the habitat types and dominant tree species present at sites occupied by breeding Cerulean Warblers. Additional analyses of CEWAP data using GIS may elucidate patterns of habitat use at the landscape and regional scales. The results of this atlas will be incorporated into PIF landbird conservation plans; in particular, lists of specific sites for management or acquisition, as well as local data on habitats used, will aid in setting regional population objectives for this species. Our intention is to publish a completed version of this atlas, along with the most up-to-date summary of conservation and management guidelines, based on CEWAP and other information.

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METHODS

CEWAP took advantage of the expertise of active birders and professional biologists by employing networks of volunteers. The Lab of Ornithology hired field assistants in 1997, 1998, and 1999 to cover areas thought to be potentially important breeding areas for ceruleans. These specific areas within states were systematically searched; however, coverage of entire states was often still incomplete.

Field protocols consisted primarily of surveying known sites (determined through state atlas workers, other birders, and published literature) to determine numbers of pairs, breeding status of population, and conservation status of site. In addition, participants surveyed as many new or potential sites as possible, to identify new breeding sites and determine status (as in the first project goal). At a small subset of sites with large or important populations, additional data on nesting and foraging, as well as productivity and threats to populations, was available through collaborating researchers.

Because of our reliance on volunteers and unsupervised field assistants, and the large differences in terrain and habitats surveyed, there was much variation in actual survey methods employed in the field. A majority of data came from variations on the "area-search" method, where observers moved through potential habitats noting presence and numbers of singing male Cerulean Warblers. Variations ranged from systematic surveys along all navigable waterways by canoe in the Montezuma Wetlands Complex of NY (Bill Evans), to driving slowly along rural roads in northern NJ (John Benzinger), to hiking the Appalachian Trail in Virginia and North Carolina, to floating stretches of several rivers in Missouri, to systematically driving and hiking through forested regions and conducting point counts wherever ceruleans were detected (David Buehler), to spot-checking isolated woodlots. Field surveys often used recorded Cerulean Warbler vocalizations (as needed) to elicit responses from territorial males, approximate territorial boundaries (especially in linear habitats), and determine pairing status (females often respond to tapes within their territories). After visits to a site were completed, observers were asked to attempt an estimate of the total breeding population of Cerulean Warblers at that site.

In addition to these CEWAP surveys, we received several datasets with point-count locations for Cerulean Warblers, often detected during more general bird surveys. In these cases, it is often impossible to know how much available habitat was covered or what proportion of a regional population of Cerulean Warblers was sampled—these are retained in our Atlas as minimum estimates for these areas. In a few states we relied on additional surveys conducted prior to CEWAP or as part of independent research efforts. Finally, some holes in our Atlas were filled by gleaning miscellaneous records from birding e-mail lists, recently published Breeding Bird Atlases, or by hounding certain birders and state biologists until they told us what they knew.

We instructed participants to define a "site" as any contiguous patch of similar and suitable habitat surrounded by a different habitat type. Because of the great variation in survey methods and types of data we received, the actual designation of sites in our database is highly inconsistent. These range from specific locations of individual Cerulean Warblers within a larger contiguous area, to politically defined State Park or Wildlife Management Area boundaries, to entire river valleys with their adjacent slopes. In all cases; however, a "site" represents a ***unique latitude and longitude*** provided by a participant and entered into our database. Although this variation leads to difficulties in interpreting numbers or proportions of sites occupied in various regions or states, this flexibility in our protocols enabled us to receive the maximum amount of data from the widest group of volunteers and collaborators.

All sites were located on topographic maps, and data on habitat, landscape characteristics, and land ownership were noted on simple data forms. Specifically, field observers recorded site location, latitude and longitude, elevation, history of disturbance, general habitat type (riparian, swamp forest, dry slope, etc.), three or more dominant tree species, and canopy height. This information was compiled and entered into a GIS database by Lab of Ornithology biologists.

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RESULTS

Range-wide Summary

A total of 280 CEWAP participants and collaborators reported data on Cerulean Warblers; these included 29 paid field assistants hired over the 3-year period (Table 1; see also Appendix 1 for complete list of CEWAP participants). The sum of data we received accounted for 7,669 Cerulean Warblers at 1,923 sites in 28 states, plus Ontario. Virtually all reports were of singing males; therefore numbers reported throughout this Atlas are assumed to represent number of territorial males or breeding pairs. An additional 355 sites were searched with no birds found; in general observers only reported positive sightings, and these do not represent random samples of available areas or habitats. Note too, that "sites" ranged in scope from individual point-locations to whole river valleys, so these data provide only a rough indication of number of different areas that support Cerulean Warbler populations.

Table 1. Summary of CEWAP participants, numbers of sites, and number of Cerulean Warblers reported, by state, 1997–1999.

State	*Number of participants signed up*	*Number returning data*	*Number of sites surveyed*	*Number of sites with birds*	*Number of birds found*
Alabama	7	1	6	6	7
Arkansas	12	4	48	46	145
Connecticut	22	7	20	13	34
District of Columbia	4	0	-	-	-
Delaware	6	2	7	7	10
Georgia	18	5	16	14	22
Iowa	9	2	9	9	22
Illinois	26	3	32	21	1000+
Indiana	22	8	73	34	342
Kansas	1	1	1	1	1
Kentucky	17	8	113	59	140
Massachusetts	22	6	11	10	18
Maryland	17	6	11	9	16
Maine	4	0	-	-	-
Michigan	36	15	183	176	507
Minnesota	17	4	57	57	103
Missouri	14	5	32	31	301
Mississippi	2	0	-	-	-
Nebraska	2	1	1	1	1
New Hampshire	5	0	-	-	-
New Jersey	18	7	32	31	157
New York	159	57	286	246	1068
North Carolina	19	12	42	39	109
Ohio	46	17	78	62	264
Oklahoma	2	0	-	-	-
Ontario	9	1	5	4	228
Pennsylvania	81	38	206	182	548
Rhode Island	3	1	1	0	0
South Carolina	3	0	-	-	-
South Dakota	2	2	2	2	3
Tennessee	27	14	488	485	1210
Virginia	48	15	106	64	152
Vermont	13	2	4	3	3
Wisconsin	25	10	60	59	174
West Virginia	68	27	345	254	1124
TOTALS	786	280	2274	1923	7669

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The scope and distribution of rangewide surveys is illustrated in Map 1 (frontispiece). Populations were surveyed throughout the entire range of the species, although coverage in many areas was patchy or incomplete. The largest number of birds were found in Tennessee, West Virginia, New York, and Illinois (Table 1; see state summaries below). These numbers require additional interpretation; however, because relative coverage of available sites varied greatly among states. For example, coverage was fairly complete near the periphery of the species' range (counts in NY and IL therefore may be close to total state populations), whereas only a sample of areas was covered in states near the center of the range (WV, TN, PA, KY).

The largest gaps in our overall atlas coverage were in Kentucky (entire state), western Maryland and Virginia, southern Ohio, and the Missouri Ozarks. In addition, many areas of West Virginia, Pennsylvania, Arkansas, and southern Indiana were only partially surveyed.

Although population estimates may not be representative for many states, CEWAP identified a large number of specific areas that are currently known to support significant populations of Cerulean Warblers. For example, nearly 60% of all birds found were concentrated in 37 geographic areas in 16 states and Ontario (Table 2). Areas with the largest concentrations included the Cumberland Mountains northwest of Knoxville, Tennessee, the Montezuma Wetlands Complex and adjacent areas in central New York, Kaskaskia River Valley and Shawnee National Forest in southeastern Illinois, Jefferson Proving Ground of southern Indiana, Queens University Biological Station in southeastern Ontario, Kalamazoo River of southwestern Michigan, the Eleven Point and Upper Current Rivers in Missouri, Shenendoah National Park and Blue Ridge Highway in western Virginia, and the Delaware River Valley and adjacent highlands of northwestern New Jersey. The total population in West Virginia, Kentucky, and western Pennsylvania is certainly much higher than these numbers, but Cerulean Warblers are less concentrated in specific areas (i.e. the habitat is more continuous).

An additional 36 areas supported from 20-50 singing male Ceruleans and accounted for another 978 (13%) of the total birds detected (Table 3). These may represent secondary areas for long-term monitoring of Cerulean Warbler populations.

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Table 2. Areas supporting the largest Cerulean Warbler populations (≥ 50 pairs), rangewide. These locations may represent primary areas for future population monitoring. See state summaries for more specific locations and information on these areas.

# Birds	State	Area	Habitat Type
430	TN	Royal Blue Wildlife Management Area, Cumberland Plateau	Mesic slopes, cove forest
325	NY	Montezuma Wetlands Complex	Riparian, forested wetland
300+	IL	Kaskaskia River	Mixed floodplain
238	TN	Center Hill Lake Area, Edgar Evins State Park	Mesic slope, dry slope
202	IN	Jefferson Proving Ground	Mesic upland forest
200	ON	Bedford/Queen's University Biological Station	Upland, bottomland
200+	IL	Illinois Ozarks, Shawnee National Forest	White-oak dominated forest slopes
177	MI	Kalamazoo River, Allegan State Game Area	Riparian, swamp forest
167	NY	Allegheny State Park and vicinity	Riparian, dry slopes
150+	IL	Cave/Cedar Creek	Sycamore-boxelder
142	TN	Frozen Head State Park	Mesic slopes
138	NY	Iroquois NWR, Oak Orchard WMA, Tonowanda Indian Reservation	Riparian, forested wetland
137	MO	Eleven Point River	Riparian
121	AR	Ozark National Forest	Upland, bottomland
114	MO	Upper Current River	Riparian
108	VA	Blue Ridge Parkway, Shenendoah National Park	Dry slope, mesic cove forest
100+	IL	Pere Marquette State Park, Big Rivers	White oak-pecan-black locust
100	MI	Fort Custer and vicinity	Dry upland forest
95	NY	Galen Wildlife Management Area	Riparian, forested wetland
94	WV	New River Gorge—Garden Ground Mountain Area	Dry slopes, riparian
90	NJ, PA	Delaware River Valley	Riparian, adjacent slopes
78	WV	Kanawha State Forest	Mesic cove forest, dry slope, riparian
78	WV	Guyandotte Mountain and vicinity	Upland forest
75+	KY	Daniel Boone National Forest	Upland forests
75	TN	Chickasaw National Wildlife Refuge	Riparian swamp forest
71	WI	Lower Wisconsin River drainages	Riparian, adjacent slopes
69	PA	Jennings Environmental Center, Moraine State Park	Dry slope, lake margin
65	WV	Louis Wetzel WMA	Dry slope, riparian
63	NY	Salmon Creek	Riparian, mesic slope
60	NC	Blue Ridge Parkway, Pisgah National Forest	Dry slope, cove forest
56	OH	Shawnee State Park and Forest	Dry slope, riparian
54	TN	Meeman Shelby State Park, Mississippi Delta region	Mesic slope, riparian
50+	IL	Mississippi Palisades State Park and vicinity	White oak-walnut-black locust forest
50+	IL	Rock River	Riparian forest
50	NJ	Kittatinny Mountains	Mesic and dry slopes
50	WV	Beech Fork State Park	Lake margin, dry slope
50	WV	North Bend State Park and Rail Trai, Mountwood Park	Dry slope, cove forest, riparian

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Table 3. Areas supporting moderate-sized (20–50 singing males) Cerulean Warbler populations rangewide. These locations may represent secondary areas for long-term monitoring.

# Birds	State	Area	Habitat Type
45	OH	Lake Metroparks	Riparian, dry slope
44	MI	Waterloo Recreation Area	Dry upland forest
42	PA	Juniata River and vicinity	Riparian
40	WV	Greenbrier River drainage and adjacent mountains	Dry slopes
36	WV	Fork Creek WMA—Little Coal River and vicinity	Riparian, mesic slope
34	OH	Zaleski State Forest/ Lake Hope State Park	Mesic slope, dry slope
34	MO	Courtois Creek	Riparian
33	NY	Bear Mountain State Park	Dry slope, bottomland
32	OH	Waterloo Township—Hewett Fork	Dry slope, mesic slope
32	TN	Cheatham Wildlife Management Area	Dry slope, mesic slope
31	WI	Lower Wisconsin River	Riparian, mesic slope
29	OH	Cuyahoga Valley National Recreation Area, Brecksville Reservation—Cleveland Metroparks	Riparian, dry slope
29	PA	Peter's Mountain and State Game Lands	Dry slope, lake margin
28	TN	Natchez Trace Parkway, National Park	Dry slope, mesic slope
28	WV	Murphy Preserve	Moist cove forest, dry slope, riparian
26	NY	Castleton Island State Park	Riparian, river island
25	NJ	Hamburg Mountain and vicinity	Dry slope, lake margin
25	TN	Mill Creek Rd.	Dry slope
24	MI	White River	Riparian
24	WI	Wyalusing State Park	Dry slope, mesic slope
23	PA	Brady's Run County Park	Dry slope
23	WV	Coopers Rock State Forest	Mesic slope, dry ridgetop
22	MI	Brown County State Park	Upland, lake margin, riparian
22	PA	Forbe's State Forest and vicinity	Dry slope
22	VA	Canoe Lake—Hahn Property	Upland
22	WV	Ritchie Mines WMA	Dry slope
21	MI	St. Joseph River	Riparian
20	IL	Illinois River Valley	Cottonwood-oak floodplain forest
20	IL	Cache River	Mixed floodplain forest
20	MN	Murphy-Hanrehan Park Reserve and County Park	Riparian, mesic slope
20	NY	Letchworth State Park	Riparian
20	NY	West Point Military Reservation	??
20	PA	Duff Park and Boyce Park	Dry slope, riparian
20	PA	Ten Mile Creek and vicinity	Riparian, dry slope
20	VA	Clinch Ranger District, Jefferson National Forest	Dry slope, cove forest
20	WI	Lake LaGrange	Mesic slope

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Regional Summaries

USFWS Region 3

Within USFWS Region 3, CEWAP participants found a total of 1,745 Cerulean Warblers at roughly 439 sites. This does not include data from Illinois, provided by Scott Robinson, which accounted for an additional 1,000–3,000 birds in that state. CEWAP coverage was patchy throughout the region, with the most concentrated efforts in southern Michigan, southeastern Missouri, and southern Indiana. A scattering of Cerulean populations were located along the Mississippi River and its major tributaries in the upper Midwest, and in the Ohio River drainage along the southern boundary of the region. The largest single populations in the region are believed to be located in Illinois along the Kaskaskia River and Illinois Ozarks region (500+ pairs), Jefferson Proving Ground in southern Indiana (200+ pairs), Kalamazoo River and Fort Custer areas in Michigan (275+ pairs), and along the Eleven Point and Upper Current Rivers in Missouri (250 pairs). Coverage was poorest in southern Ohio and elsewhere in Indiana and Missouri, where undoubtedly many other populations exist (Map 2.)

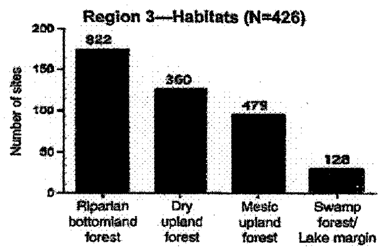
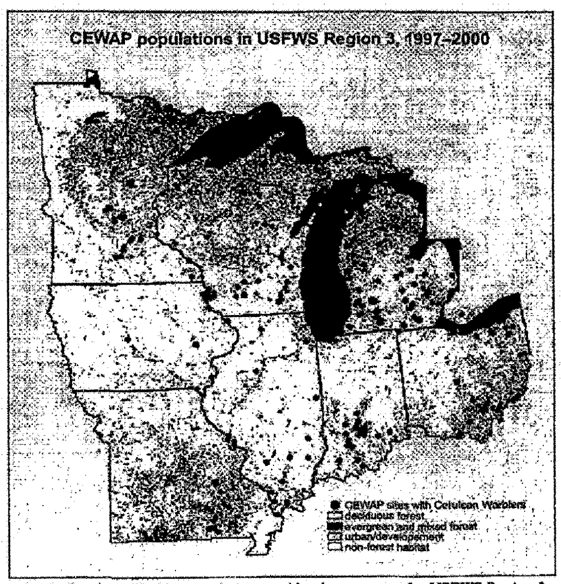


Figure 1. Habitat classifications at sites with Cerulean Warblers in USFWS Region 3. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

Overall, Cerulean Warblers showed a distinctly bimodal habitat distribution, with roughly the same numbers of birds found occupying bottomland and upland habitats. Among the 426 specific sites with habitat data, roughly 40% were in riparian bottomland forest, accounting for 485 of the Ceruleans found (not counting Illinois). An additional 305 of sites were in dry upland forest and 225 were in mesic uplands, accounting for 21% and 28% of the birds found, respectively (Figure 1).

For 164 sites in Region 3, participants provided data on the extent of available habitat at sites where Cerulean Warblers occurred. Although a quantitative analysis of forest patch size is not possible with these data, we believe that they provide a reasonable sample of the range of tract sizes used in the region. Roughly 41% of occupied sites were described as 1,000 acres or greater, accounting for 65% of all birds found (Figure 2). An additional 265 birds were found in 70 tracts between 200 and 1,000 acres, and fewer than 10% of the birds were in patches ≤ 100 acres.



Map 2. Cerulean Warbler populations and land cover types for USFWS Region 3.

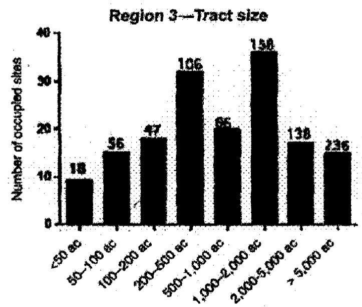


Figure 2. Numbers of occupied sites and forest tract sizes for sites in USFWS Region 3. Numbers of individual Cerulean Warblers recorded in each tract-size class are noted above the bars.

USFWS Region 4

In the Southeast region, CEWAP participants and collaborators found a total of 1,560 Cerulean Warblers at 633 specific sites (Map 3). Coverage was patchy throughout the region, ranging from intensive surveys of several key areas in Tennessee to scattered observations from many other areas. The biggest holes in atlas coverage were in eastern Kentucky. The largest Cerulean population in the region is undoubtedly in the Cumberland Mountains and Plateau areas of Tennessee and probably Kentucky. Additional significant populations were located in the Blue Ridge of North Carolina, the Ozarks of Arkansas, and in central Tennessee. Small populations were documented at the edge of the species' range in northern Georgia, northern Alabama, and the coastal plain of North Carolina (Roanoke River). No recent breeding records could be obtained in Mississippi, South Carolina, or Louisiana.

Of 550 specific sites reporting habitat data, the majority (73%) were in mesic upland and moist cove forest habitats, accounting for 575 of the birds found throughout the region (Figure 3). An additional 265 birds were found at 70 dry slope and ridgetop sites, whereas only 13% of birds were in riparian forest habitat.

For 117 sites in Region 4, participants provided data on the extent of available habitat at sites where Cerulean Warblers occurred. Although a quantitative analysis of forest patch size is not possible with these data, we believe that they provide a reasonable sample of the range of tract sizes used in the region. Roughly 74% of occupied sites were described as 1,000 acres or greater in extent, accounting for nearly 95% of all birds found (Figure 4). Only 4% of the birds found in this region were in habitat patches ≤ 200 acres.

Map 3. Cerulean Warbler populations and land cover types for USFWS Region 4.

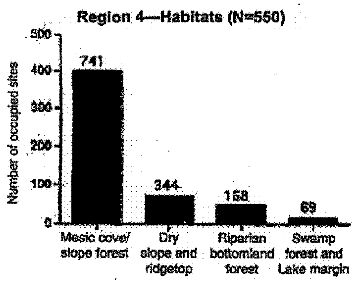


Figure 3. Habitat classifications at sites with Cerulean Warblers in USFWS Region 4. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

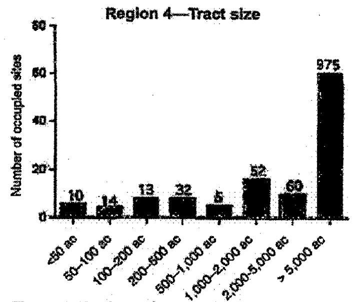
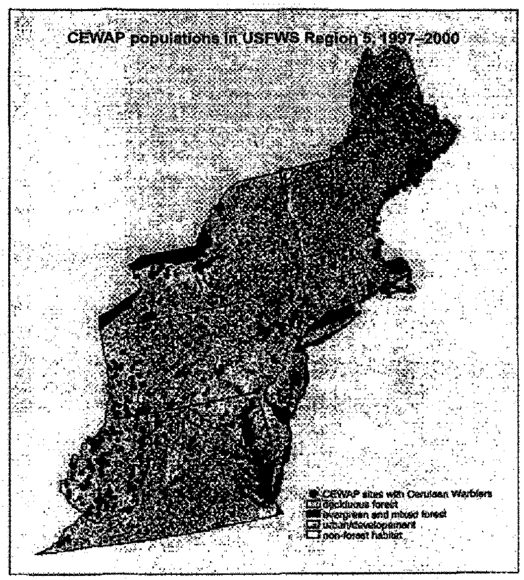


Figure 4. Numbers of occupied sites and forest tract sizes for sites in USFWS Region 4. Numbers of individual Cerulean Warblers recorded in each tract-size class are noted above the bars.

USFWS Region 5

In the Northeast Region, a total of 3,077 Cerulean Warblers were located at 820 specific sites (Map 4). Intensive surveys at many sites in West Virginia and western Pennsylvania turned up roughly 1,400 Ceruleans in the heart of the species' range—this is undoubtedly only a small fraction of the true population in these states. Outside of the Ohio Hills physiographic area, large and significant populations were documented in several areas including the Montezuma Wetlands complex and surrounding areas in central New York (400+ pairs), Allegheny State Park and National Forest area of western New York and Pennsylvania (175+ pairs), the Delaware Water Gap region of northwestern New Jersey and adjacent Pennsylvania (150+ pairs), and the Blue Ridge Parkway area of western Virginia (100+ pairs). In addition, smaller populations exist in



Map 4. Cerulean Warbler populations and land cover types for USFWS Region 5.

the Hudson River Valley and Highlands of southeastern New York, and in many parts of Pennsylvania. Small but persistent populations were found throughout southern New England, in northern New York, and in the Piedmont of Maryland and Virginia. Finally, although not in this USFWS Region, a large population of Cerulean Warblers exists in Ontario, not far from the New York border.

As in other regions, Cerulean Warblers exhibit a distinctly bimodal habitat distribution in the Northeast. Of the 800 specific sites with habitat data, 43% were in riparian or other bottomland forest habitats, accounting for 44% of individual Ceruleans found (Figure 5). An additional 39% of birds were found at 256 dry slope or ridgetop sites, with the remainder of birds in other upland habitats.

For 333 sites in Region 5, participants provided data on the extent of available habitat at sites where Cerulean Warblers occurred. Although a quantitative analysis of forest patch size is not possible with these data, we believe that they provide a reasonable sample of the range of tract sizes used in the region. Roughly 19% of occupied sites were described as 1,000 acres or greater in extent, accounting for 40% of all birds found (Figure 6). This is a much lower proportion than in the other two regions. In contrast, 57% of occupied sites were described as ≤ 100 acres, supporting 29% of the Ceruleans found in this region. Whether these data indicate a lower threshold of area sensitivity by Cerulean Warblers in the Northeast, compared with other regions, or whether the range of available habitats searched was different, is unclear.

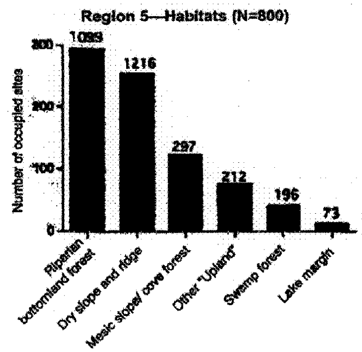


Figure 5. Habitat classifications at sites with Cerulean Warblers in USFWS Region 4. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

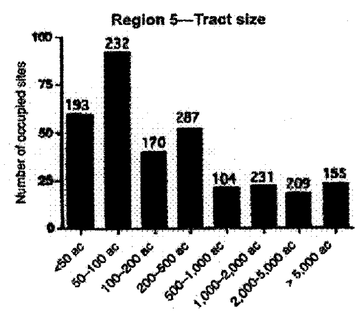
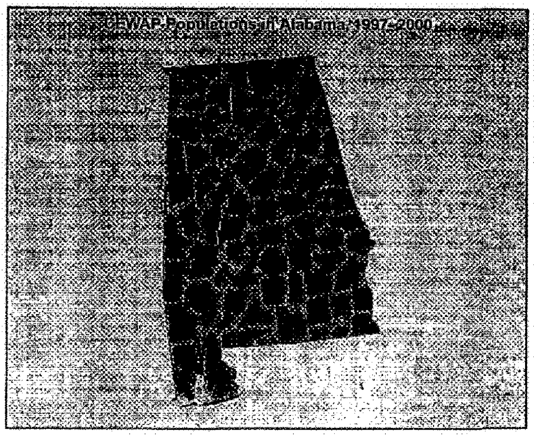


Figure 6. Numbers of occupied sites and forest tract sizes for sites in USFWS Region 5. Numbers of individual Cerulean Warblers recorded in each tract-size class are noted above the bars.

State Summaries

Alabama

Our current data for Alabama (Map 5) comes from Eric Soehren (e-mail communication, Oct. 2000), who reported birds from two sites in the Bankhead National Forest (Lawrence and Winston counties). Five birds were observed in the Sipsey Wilderness and 2 were noted along Flannagin Creek. The total population for this area is thought to possibly be much larger, and more systematic surveys are recommended.



Map 5. Cerulean Warbler populations in Alabama. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Arkansas

There is little published information on the presence/absence or relative abundance of Cerulean Warblers in Arkansas; however, Hamel (2000) does cite a few references suggesting that the species is common in the Ouachita National Forest and western Ozarks. The primary area searched by CEWAP participants was the Ozark National Forest in the northwestern part of the state (Map 6). It is likely that additional populations exist in the Ouachita National Forest and unsearched areas of the Mississippi Delta region.

CEWAP participants observed 145 birds at 46 (96%) of 48 sites visited in Arkansas. Of these, 121 (83%) were noted in the Ozark National Forest and 14 (10%) were detected in Desha and Prairie counties of the Mississippi Delta region (Table 4). No birds were discovered at two separate sites along the Ouachita River (near Callion) and the Saline River (near Rison). Data from the Ozark National Forest consisted of individual Cerulean Warblers reported on point counts; it is unclear how complete this sampling was for the species in this region.

Table 4. Important areas for breeding Cerulean Warblers in Arkansas.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
121	Ozark National Forest	6 counties	Upland, bottomland	750–2250
14	Mississippi Delta region	Desha, Prairie	Bottomland	145–183

Map 6. Cerulean Warbler populations in Arkansas. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Of the 46 sites with Ceruleans, 35 (76%) were classified as upland and 12 (25%) were bottomland (Figure 7). Upland sites accounted for 113 (79%) Cerulean observations, whereas 30 (21%) birds were observed in bottomland habitats.

Among the 33 sites that recorded tree species, upland sites were dominated by oaks (mostly red oak) and hickories, whereas bottomland sites reported sweetgum, maples, and sycamore (Figure 8).

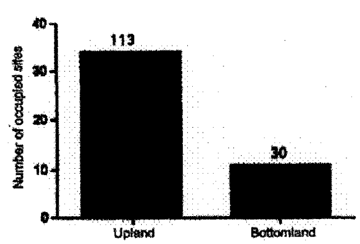


Figure 7. Habitat classifications at sites with Cerulean Warblers in Arkansas. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

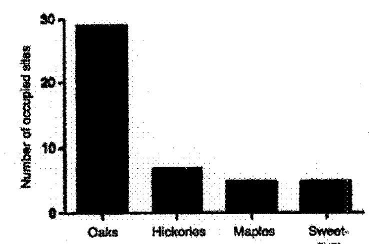


Figure 8. Predominant tree species reported at occupied sites in Arkansas. "N" equals number of sites with tree species reported by CEWAP participants.

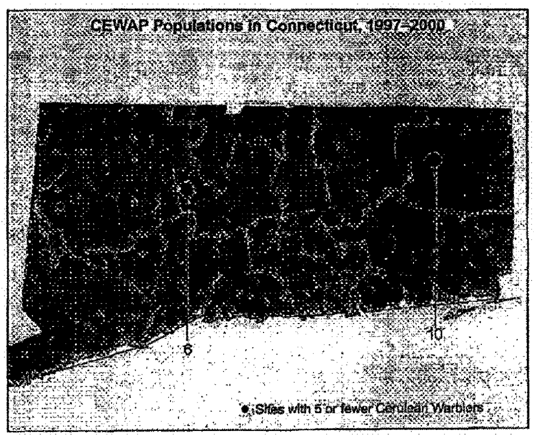
Connecticut

The *Atlas of Breeding Birds in Connecticut* reported Cerulean Warblers from 6.5% of all atlas blocks (Bevier 1994). CEWAP coverage in Connecticut was patchy, but distributed in several regions. Ceruleans were observed in all regions searched, except the extreme southwest corner near the towns of Redding and Weston (Map 7).

CEWAP participants counted 34 birds at 13 (65%) of 20 sites visited in Connecticut. Of the 34 individuals, 10 (29%) were noted in Natchaug State Forest in Windham County. Other important areas for Ceruleans included habitat along the Housatonic River in Litchfield County and the Session Woods Wildlife Management Area in Hartford County (Table 5). Additional single birds were found at Kahn Preserve near New Milford, Nehantic State Forest near Lyme, Bend of the River Audubon Center near Southbury, and the Yale Forest in Windham County. Among the areas searched that did not have Ceruleans were Devil's Den Preserve and Limekiln Natural area in Fairfield County.

Riparian and other bottomland sites accounted for 16 of the 34 cerulean observations, whereas 12 Ceruleans were noted in upland forest habitats (Figure 9).

Oaks and maples were the most commonly reported tree species at occupied sites; however, birch, hickory, sycamore, and eastern hemlock were also reported (Figure 10). The Natchaug State forest is a 12,500 acre site dominated by red oak, white oak, black oak and hickory, whereas sites along the Housatonic River had sycamores, red and silver maples, white oaks, and ash.



Map 7. Cerulean Warbler populations in Connecticut. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 5. Important areas for breeding Cerulean Warblers in Connecticut.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
10	Natchaug State Forest	Windham	Lake margin, dry slope	??
6	Housatonic River—Kent, Bull's Bridge	Litchfield	Riparian	370
5	Session Woods WMA	Hartford	Riparian	750
3	Pleasant Valley Nature Preserve	Middlesex	??	??
3	Hartman Park, Lyme	Middlesex	??	??
2	Still River Preserve	Litchfield	Riparian	250

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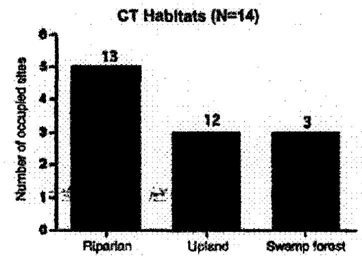

Figure 9. Habitat classifications at sites with Cerulean Warblers in Connecticut. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

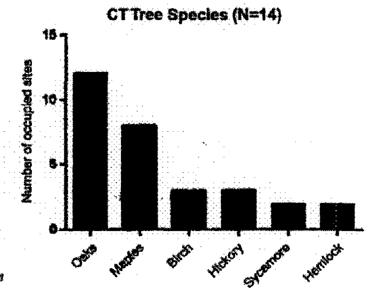

Figure 10. Predominant tree species reported at occupied sites in Connecticut. "N" equals number of sites with tree species reported by CEWAP participants.

Delaware

Hamel (2000) reported that "Preliminary results from the Delaware Breeding Bird Atlas indicate the birds were found in two blocks in the northern part of the state (Lisa Gelvin-Innavaer, pers. comm., 18 Sept. 1996)."

CEWAP participants counted 10 Cerulean Warblers at 7 sites in the northern Delaware county of New Castle (Map 8). All these birds were along White Clay Creek in riparian and adjacent upland forest. The forest was dominated by sycamore, maples, tulip tree, and walnut. This area is adjacent to a site with two additional birds at the White Clay Creek Preserve in Chester County, PA.

Map 8. Cerulean Warbler populations in Delaware. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

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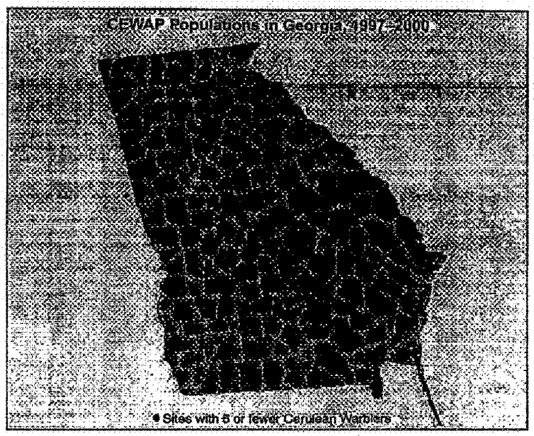
Georgia

CEWAP surveys yielded 22 birds at 14 (87%) of 16 sites visited (Map 9). Nearly all the birds were on the Chattahoochee National Forest in Union County, between 2,640 and 3,400 ft. elevation, either on dry slopes or in cove forest. Specific sites on the national forest included Walnut Knob, Poplar Knob, Rogers Knob, Steedly Mountain, and Rockface Lead.



Map 9. Cerulean Warbler populations in Georgia. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Illinois

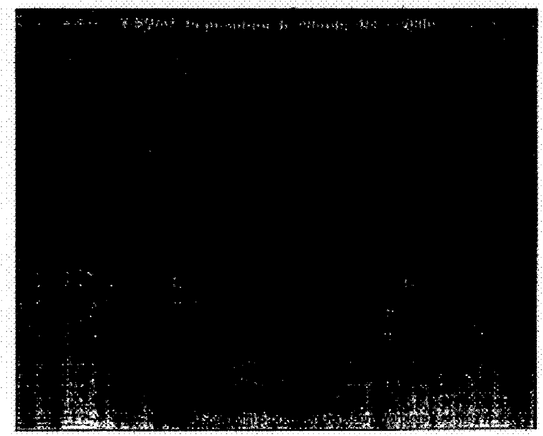
Our knowledge of Cerulean Warblers in Illinois comes primarily from Scott Robinson and Glendy Vanderah of University of Illinois at Urbana-Champaign, who completed statewide surveys for this species between 1992 and 1997. We are grateful to these researchers for sharing their unpublished data, which make up the bulk of our account, below. A few additional observers surveyed about 8 sites during the CEWAP, but we did not solicit participation in Illinois in light of the recently completed surveys (Map 10).

Robinson and Vanderah completed 2,587 census points and 253 census routes, sampling 117 forest tracts statewide. They estimated Cerulean Warbler abundance in 21 regions of the state and extrapolated to produce a range of population estimates for each area. The results of this ambitious survey yielded a statewide population of between 1,000 and 3,000 singing male Cerulean Warblers. More than 75% of these were concentrated in four areas in the southwest portion of the state—Kaskaskia River Valley, Pere Marquette State Park and Big Rivers along the Mississippi River, Cave/Cedar Creek, and the Illinois Ozarks (Table 6). Smaller populations occur further north along the Mississippi River and along a few other river systems. The highest density of singing males (0.66 per 50-m point count) was found at the Cave/Cedar Creek sites.

Habitat selection varied across the state, with the majority of birds occupying tall, diverse floodplain forests or white-oak dominated slopes. An interesting situation occurred locally in black locust groves within larger forest tracts. At Pere Marquette State Park, Cerulean Warbler territories in black locust ranged from 2 (1996, 1997) to 15 (1996), presumably a response to local outbreaks of lepidopteran larvae on this tree species. Similarly, at Mississippi Palisades State Park, number of territories in black locust ranged from 1 in 1994 to 13 in 1992.

Cerulean Warblers in Illinois occurred with much greater frequency in larger forest tracts (Figure 11).

(Continued on page 19)



Map 10. Cerulean Warbler populations in Illinois. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 6. Important areas for breeding Cerulean Warblers in Illinois (data from Robinson and Vanderah, unpublished).

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
300–1,000	Kaskaskia River	Clinton, St. Clair, Washington	Mixed floodplain forest	420
200–500	Illinois Ozarks, Shawnee National Forest	Jackson, Union	White oak dominated slopes	400–600
150–300	Cave/Cedar Creek	Jackson	Sycamore, boxelder forest	??
100–200	Pere Marquette State Park, Big Rivers	Jersey	White oak-pecan-black locust forest	420–600
50–150	Mississippi Palisades State Park and vicinity	Carroll, Jo Daviess	White oak-walnut-black locust forest	500–750
50–100	Rock River	Ogle, Lee, Whiteside	Riparian	600
20–50	Illinois River Valley	various	Cottonwood-oak floodplain forest	450–600
20–50	Cache River	Johnson, Pulaski	Mixed floodplain forest	400–450
10–50	Till Plain region	various	??	420–450
10–20	Little Wabash River	White, Gallatin	??	420
10–20	Big Muddy River	Franklin	Mixed floodplain forest	420

Roughly half of 48 tracts ≥ 500 ac (200 ha) were occupied, whereas only 2 of 42 tracts < 80 ha (200 ac) had birds. Rates of nest parasitism by Brown-headed Cowbirds were relatively high; e.g. 75% in Illinois Ozarks and 80% at Mississippi Palisades State Park.

Robinson and Vanderah point out that Illinois is near the center of the Cerulean Warbler's historic range and that the species was abundant there during the 1800s. Today the species is "rare, patchy, and extremely area sensitive." They were found to be absent or very rare in (1) drier forests on poor or sandy soils; (2) pure tree plantations (pines, sweetgum, tulip-tree); (3) younger or heavily logged forests; (4) urban woodlots; and (5) forest patches < 200 ha (500 ac) that are scattered through the agricultural landscape.

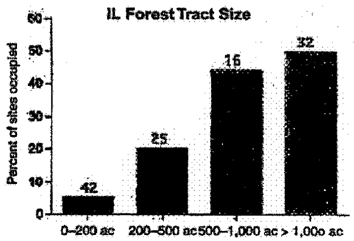
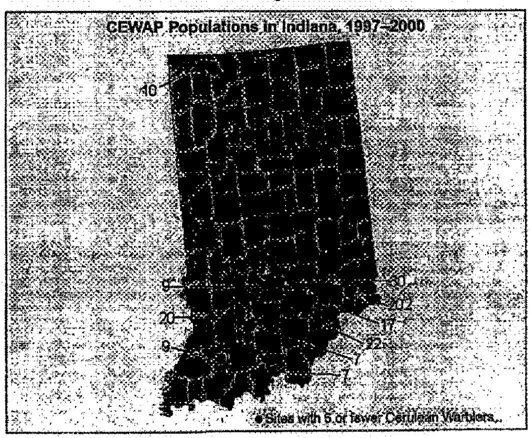


Figure 11. Percent of forest tracts in four size classes occupied by territorial Cerulean Wablers in Illinois. Numbers of sites sampled are above bars. Data from S. Robinson and G. Vanderah unpublished.

Indiana

The *Atlas of Breeding Birds of Indiana* (Bruner 1998) reports that Cerulean Warblers were found at 21% (347) of atlas blocks statewide. Ceruleans were most numerous in atlas blocks located in the southeastern and south-central portions of the state. CEWAP coverage in Indiana was confined primarily to the southern one-third of the state.

CEWAP participants counted 342 birds at 34 (47%) of 73 sites searched in Indiana. The 7,700-acre Jefferson Proving Ground in Jefferson, Ripley, and Jennings counties accounted for 202 (59%) of the Cerulean sightings (Map 11). Other important areas included Brown County State Park and Muscatatuck National Wildlife Refuge, which combined accounted for 39 observations (Table 7). Roughly 60 birds were found at various locations in the vicinity of Lake Monroe southeast of Bloomington. An isolated population at Indiana Dunes on Lake Michigan consisted of at least 10 individuals.



Map 11. Cerulean Warbler populations in Indiana. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Although only 7 (21%) of the 34 sites were classified as mesic upland, this habitat type accounted for 247 (72%) of Cerulean observations (Figure 12). Roughly 97 birds were found in various bottomland and lake-margin habitats in Indiana, and an additional 34 individuals were found in dry upland forests.

Maples and sycamore were reported from the largest number of occupied sites (Figure 13); however, the site with the largest population (Jefferson Proving Ground) was dominated by white oak and tulip tree. Bottomland sites consisted primarily of sycamore and maples, with black walnut and elms also frequently reported.

Table 7. Important areas for breeding Cerulean Warblers in Indiana.

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
202	Jefferson Proving Ground	Jefferson, Ripley, Jennings	Mesic upland forest	900
22	Brown County State Park	Brown	Upland, lake margin, riparian	650–750
17	Muscatatuck NWR	Jackson, Jennings	Swamp forest, mesic slope	550
10	Indiana Dunes National Lakeshore	Porter	Swamp forest, riparian	600–650
10	Turkey Creek Bottom	Martin	Bottomland	520
9	Gross Road	Monroe	Mesic and dry upland	550–720
9	Patoka River	Pike	Riparian	420
7	Little Blue River	Monroe	Riparian	400
7	Tank Spring Bottom	Martin	Bottomland	510–530
6	Goldsberry Hollow	Martin	Bottomland	480–510
5	Camp Roberts Cove	Brown	Bottomland	710–850
5	Rogers Road	Monroe	Moist Cove forest	660–770

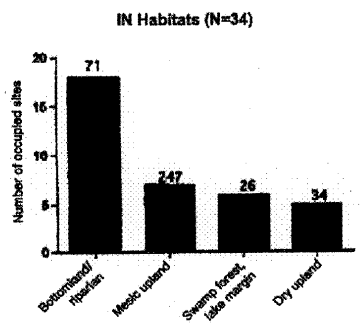


Figure 12. Habitat classifications at sites with Cerulean Warblers in Indiana. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

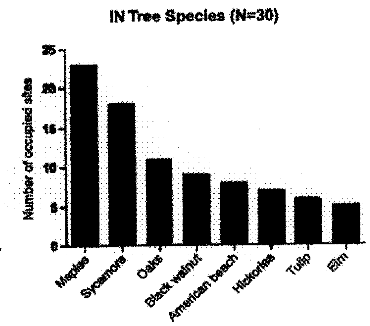
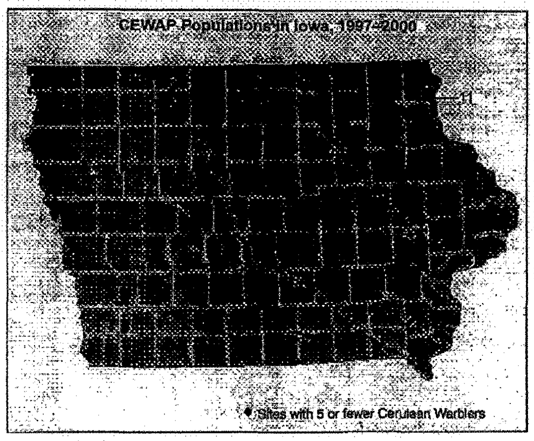


Figure 13. Predominant tree species reported at occupied sites in Indiana. "N" equals number of sites with tree species reported by CEWAP participants.

Iowa

The *Iowa Breeding Bird Atlas* reported ceruleans from 44 (6%) atlas blocks in 28 counties. However, these observations occurred mainly in priority blocks that had been selected because they contained large amounts of forest. Most reports were from extreme eastern Iowa and the DeMoines River floodplain (Cecil 1996).

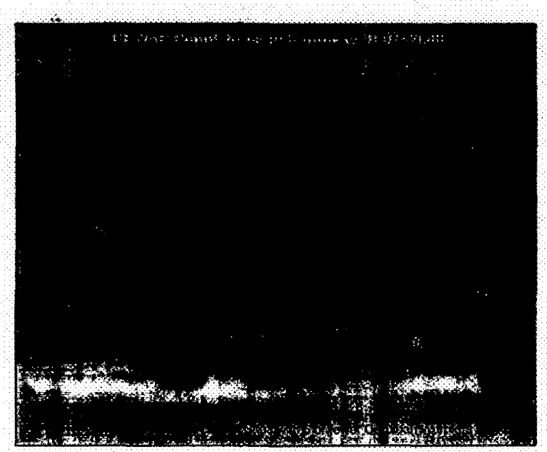
CEWAP participants tallied 22 ceruleans at 9 sites in 6 counties (Map 12). The most important sites were located along the Mississippi River in Allamakee and Clayton counties, where 11 birds were observed.



Map 12. Cerulean Warbler populations in Iowa. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Kansas

CEWAP participants documented 1 cerulean at the Western Bend Bottomlands on the Fort Leavenworth Military Reservation. The bird was in riparian forest dominated by sycamore, cottonwood, and ash. This was the only site surveyed by CEWAP. Other populations may exist in the eastern part of the state (Thompson and Ely 1992).



Map 13. Cerulean Warbler populations in Kentucky. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Kentucky

The Kentucky Breeding Bird Atlas (Palmer-Ball 1996) reports Cerulean Warblers from 16% of priority atlas blocks statewide. They were "fairly widespread" in the Cumberland Plateau and Mountains regions and "very locally distributed" over much of the remainder of the state. Hamel (2000) notes that the current status in Kentucky is very different from older accounts which state that this species was much more common and widespread.

This state received limited coverage from CEWAP participants. Most of our reports came from two sources: a point-count dataset from the Daniel Boone National Forest in eastern Kentucky (Linda Perry), and some additional surveys conducted through the KY Department of Fish and Wildlife Resources (Steve Thomas). Consequently, our atlas leaves large gaps, especially in the Cumberland Plateau region.

Data from Daniel Boone National Forest reveals a minimum of 71 birds from 96 point counts, primarily in the Pioneer Weapons area, Wolf knob, Somerset and London Borea districts. We have no habitat data associated with these points. Other surveys reported an additional 67 Ceruleans from 20 sites, mostly state owned parks and management areas. The most birds found were 15 at Beech Creek WMA (Clay County), 7 birds each at Kentenia State Forest (Harlan County) and Fleming WMA (Fleming County), and 6 Ceruleans at Sloughs WMA (Union and Henderson Counties) (Map 13).

Of the latter 20 sites, 10 were dry slopes or ridges, accounting for 33 individuals, 3 sites were in moist cove forest with 8 birds, and 7 sites were in bottomland areas including swamp forest and lake margins, accounting for 28 Ceruleans. White oak, shagbark hickory, tulip tree, and maples were the most frequently reported trees at upland sites, whereas sycamore, sweetgum, red maple and elms were most frequent at bottomland sites.

Map 14. Cerulean Warbler populations in Massachusetts. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Massachusetts

Veit and Peterson (1993) estimated the total Massachusetts population of breeding Cerulean Warblers to be 5 to 10 pairs.

CEWAP participants documented 18 Ceruleans at 10 of 11 sites visited across the state, with several sites reporting 2 to 3 singing males present (Table 8). Areas with Ceruleans include several in the Connecticut River drainage in Franklin County, two sites along Quabbin Reservoir, and surprisingly, two sites in eastern Massachusetts in Plymouth county (Map 14). About half of the birds found were in riparian or bottomland forest, and half in dry uplands.

Dominant tree species at occupied sites include oaks (red oak, white oak, northern red oak) and hickories in the uplands, red-maple swamp, and diverse riparian forests with cottonwood, willow, maples, oaks, birches, hemlock, and white pine.

Table 8. Important areas for breeding Cerulean Warblers in Massachusetts.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
4	Quabbin Reservoir (West slope and Whitney Hill)	Hampshire, Worcester	Dry slope	750–800
3	Little Wachusetts Mountain	Worcester	Dry slope	1279
3	Poets Seat—Greenfield	Franklin	Riparian	300
2	Stillwater—Deerflield	Franklin	Riparian	175
2	Middleboro	Plymouth	Swamp forest	50
2	Knightville Dam	Hampshire	Mesic forest	610–787
1	Dunbar Valley, Monroe State Forest, Rowe	Franklin	Riparian	1500
1	Erwin S. Wilder WMA	??	Dry slope	??

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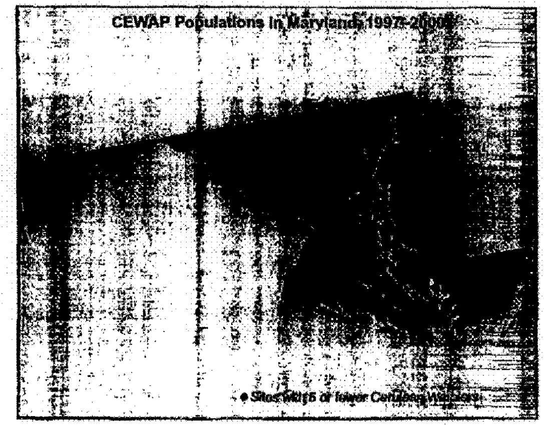

Map 15. Cerulean Warbler populations in Maryland. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Maryland

Robbins and Blom (1996) report Cerulean Warblers at 165 out of 1,256 possible Breeding Bird Atlas blocks. The species was most common and widespread in the narrow ridge and valley of western Maryland, including Catoctin Mountain area, and locally distributed along rivers flowing down through the Piedmont.

CEWAP surveys yielded only 16 Ceruleans on 9 (82%) of 11 sites surveyed. Nine (56%) of the 16 observations came from Howard County in the central part of the state (along Patuxent and Patapsco Rivers) and four observations came from the Big and Little Patuxent Rivers in Anne Arundel and Prince Georges counties (Map 15). Two individuals were noted at Catoctin Mountain Park in Frederick County, and an anomalous bird was at Greenwell State Park near the mouth of the Patuxent River in St, Mary's County. The lack of surveys conducted in the ridge and valley of western Maryland, where this species is undoubtedly quite common, represents one of the largest gaps in this rangewide atlas.

All but the Catoctin birds were in riparian forests dominated by sycamore, tulip tree, and silver maple. The upland birds were in sugar maple-basswood forest.

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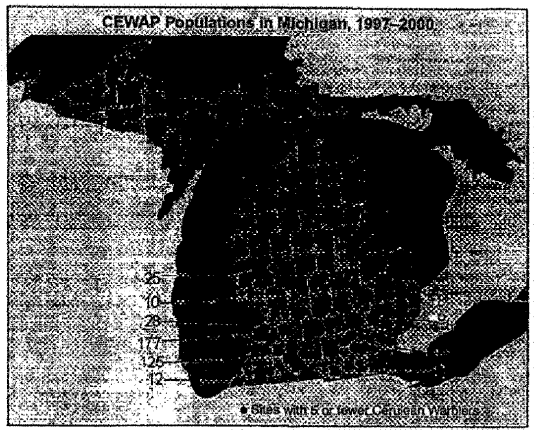


Map 16. Cerulean Warbler populations in Michigan. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Michigan

The *Atlas of Breeding Birds of Michigan* (Brewer, et al. 1991) reports Cerulean Warblers from 155 (8.2%) of 1,896 townships, with 143 (92%) of these observations coming from the southern Lower Peninsula.

CEWAP surveys yielded a total 507 birds at 176 (96%) of 183 sites (Map 16). Two sites in Alleghan County, the Alleghan State Game Area and Kalamazoo River, accounted for 177 (35%) of the 507 birds observed (Table 9). Other important areas included Fort Custer in Kalamazoo and Calhoun counties, and the Waterloo Recreation Area in Washtenaw and Jackson counties.

Sites containing dry upland forest and riparian/swamp forest accounted for 185 (36%) and 150 (30%) cerulean observations, respectively. These two habitat types were present at 149 (85%) of 175 sites where habitat conditions were reported (Figure 14).

Of 129 sites where tree species were reported, 99 (78%) contained oaks and 51 (39%) contained maples. Other commonly reported tree species included hickories, America basswood, eastern hemlock, black cherry, and black locust (Figure 15). For the 117 sites where tree species data were reported, the most frequently observed species included oaks (black oak, red oak, and swamp white oak), maples (silver maple, sugar maple and red maple) and willow species.

Table 9. Important areas for breeding Cerulean Warblers in Michigan.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
177	Alleghan State Game Area and Kalamazoo River	Alleghan	Riparian, swamp forest, mesic forest	600–700
100	Fort Custer and vicinity	Kalamazoo, Calhoun	Dry upland forest	820–1010
44	Waterloo Recreation Area	Washtenaw, Jackson	Dry upland forest	984–1050
24	White River	Muskeegan, Oceana	Riparian	600
21	St. Joseph River	Branch, St. Joseph	Riparian	853–886
10	Perry Trust	Barry	Mesic Forest	951
10	Flat River State Game Area	Montcalm	Dry upland forest	820

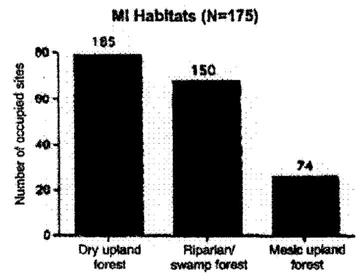


Figure 14. Habitat classifications at sites with Cerulean Warblers in Michigan. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

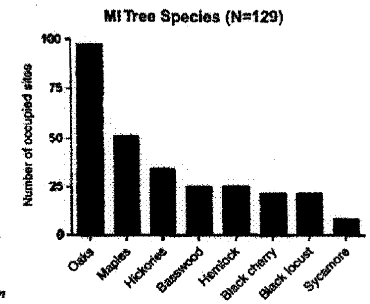


Figure 15. Predominant tree species reported at occupied sites in Michigan. "N" equals number of sites with tree species reported by CEWAP participants.

Minnesota

Citing a personal communication from Steve Stucker and Richard Baker of the Minnesota County Biological Survey, Hamel (2000) reports that "Since 1988, the Minnesota County Biological Survey has surveyed 22 counties within the range of the Cerulean Warbler. As a result of this effort, singing males were observed at 103 'locations' (or element occurrences) which can be grouped into 42 'local populations.' These consist of 8 local populations in floodplain forest and 34 local populations in upland forest. Seven of the 8 largest local populations were in upland forest."

CEWAP participants discovered 103 Cerulean Warblers at 57 sites in south-central Minnesota (Map 17). At least one individual cerulean was noted at each of the 57 sites surveyed (Table 10). Sites with greater than 10 Cerulean Warblers included Murphy-Hanrehan Reserve and County Park in Scott County, Lake Maria State Park in Wright County, and Stanley Eddy County Park in Wright County. Besides the cluster of sites in northern Wright County, a majority of birds were found near

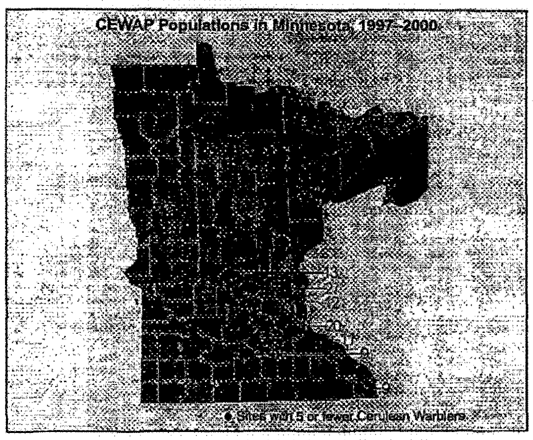
Table 10. Important areas for breeding Cerulean Warblers in Minnesota.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
20	Murphy-Hanrehan Park Reserve and County Park	Scott	Riparian, mesic slope	1000
16	Lake Maria State Park	Wright	Riparian, dry slope	??
11	Stanley Eddy County Park	Wright	Dry slope	??
9	Beaver Creek Valley State Park	Houston	Riparian, mesic slope	752
9	Seven Mile Creek County Park	Nicollet	Riparian, dry slope	??
7	Kelly Lake, MN Valley Recreation Area	Carver, Scott	Riparian	??
8	St. Johns Woods	Stearns	Riparian, dry slope	??
5	Suconnix WMA	Wright	Riparian	??
5	Harry Larson County Park	Wright	Riparian	??

the Minnesota River in Scott, Carver, and Nicollet Counties. An outlying population was at Beaver Creek Valley State Park in the southeast corner of the state. At this point, we do not know how these sites compare with the Minnesota Biological Survey database.

Of 39 sites reporting habitat conditions, 20 (51%) were classified as riparian, while 17 (44%) were in dry slope conditions. Of the 79 birds observed at these 39 sites, 41 (51%) were noted in riparian and 23 were in dry slope habitats (Figure 16).

Oaks, maples, and American basswood were the most commonly reported tree species in Minnesota (Figure 17). At upland sites, red oak, bur oak, sugar maple, and basswood were most frequently reported, whereas at riparian sites cottonwood, silver maple, red oak, ash, and elm were dominant species.



Map 17. Cerulean Warbler populations in Minnesota. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

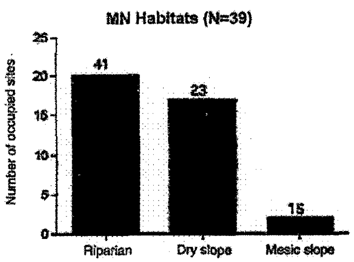


Figure 16. Habitat classifications at sites with Cerulean Warblers in Minnesota. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

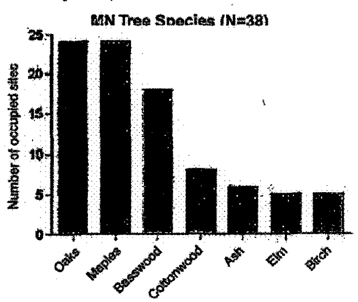


Figure 17. Predominant tree species reported at occupied sites in Minnesota. "N" equals number of sites with tree species reported by CEWAP participants.

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Missouri

The *Missouri Breeding Bird Atlas* (Jacobs and Wilson 1997) reported Cerulean Warblers from 81 (7%) of 1,207 atlas blocks statewide. Hamel (2000) states:"Some Missouri occurrences in uplands, but the major numbers are associated with riparian corridors and other areas near rivers, particularly the Current, Jack's Fork, and Eleven Point rivers in the Ozarks in southeastern Missouri." CEWAP coverage in Missouri was confined to the southeastern portion of the state within these several major riparian areas. Note the lack of surveys from the Ozarks of southwestern Missouri; given the large number of birds found in northwestern Arkansas, we expect that similarly large populations may exist in that part of Missouri as well.

Almost all of the southern half of Missouri was originally, and is again today, blanketed by oak-hickory and oak-pine forests. In 1998 Jane Fitzgerald hired Tim Kippenberger and Tom Hall to survey several rivers in this Ozark region. Tim and Tom's canoe surveys of the Black River, Courtois Creek, Eleven Point River, and Huzzah River revealed densities of over 4.5 singing males per river mile. Mark Robbins (an ornithologist from the University of Kansas) who worked in conjunction with Tim and Tom discovered densities of 3.5 singing males per river mile when floating the Upper Current River. However, there were still distinct stretches of river where warblers were not present.

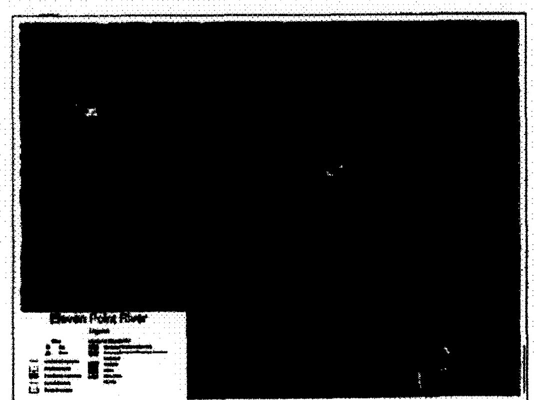
Stretches of the Eleven Point River were digitized in the fall of 1999 and entered into a GIS database at the Missouri Department of Conservation. Information on warbler distributions were then superimposed upon a map of land cover (i.e. the amount and distribution of cover types such as forest, pasture, urban areas, etc.) within a 7-mile distance on either side of the area of river in question (Map 18).

We were told that the maps would be updated sometime in 2000. An analysis will be run to determine the significance of relationships among landscape variables (e.g. percent of forest in the landscape, patterns of forest fragmentation, etc.) and warbler distributions. Results of the analyses will help us to better understand what geographic scale we need to consider as we attempt to conserve this high priority species in MO

CEWAP participants in Missouri tallied 301 ceruleans at 31 (97%) of 32 sites surveyed (Map 19). The two most important areas were the Eleven Point River with 137 (45%) birds and the Upper Current River with 114 (38%) birds (Table 11).

Twenty-three (74%) of the 31 sites with Ceruleans were classified as riparian. Not surprisingly, these riparian sites accounted for 286 (95%) of the total number of observations (Figure 18).

Commonly reported tree species at occupied sites included sycamore, oaks, and maples. Other trees reported included American walnut, pines, birches, American elm, and willows (Figure 19). Mature sycamore forest is clearly the most important habitat for Cerulean Warblers along river systems in Missouri.



Map 18. The distribution of singing male Cerulean Warblers along the Eleven Point River, outlining the 1-kilometer zone where land cover is being mapped.

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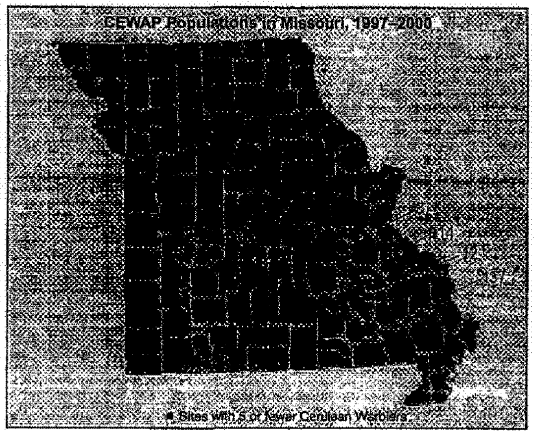


Map 19. Cerulean Warbler populations in Missouri. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 11. Important areas for breeding Cerulean Warblers in Missouri.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
137	Eleven Point River	Oregon	Riparian	495–670
114	Upper Current River	??	Riparian	??
34	Curtois Creek	Crawford	Riparian	640–680
12	Black River	Reynolds	Riparian	570

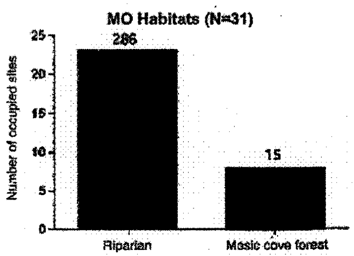


Figure 18. Habitat classifications at sites with Cerulean Warblers in Missouri. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

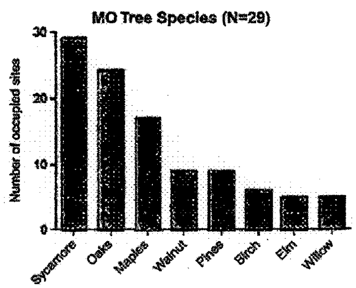


Figure 19. Predominant tree species reported at occupied sites in Missouri. "N" equals number of sites with tree species reported by CEWAP participants.

Nebraska

CEWAP participants surveyed 1site at the Fontennelle Forest in Sarpy County, where they noted 1 Cerulean Warbler. This site was in a riparian forest along the Missouri River dominated by bur oak and hickory.

New Jersey

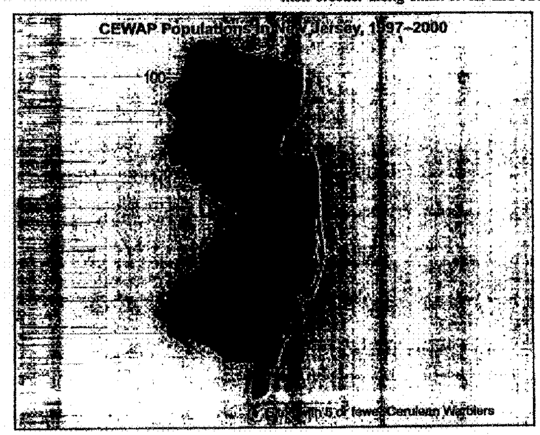
In New Jersey, the majority of our data came from John Benzinger, who conducted CEWAP surveys in 1999, and Dennis Miranda of the NJ Conservation foundation. In addition, Benzinger conducted surveys for the NJ Endangered Species and Nongame Program of the Division of Fish and Wildlife, and we gratefully acknowledge Amanda Dey for sharing results of these earlier surveys. Their quantitative assessments do not strictly follow CEWAP protocols, but provide a similar picture of habitat use in this region. Much of the following account is from Miranda (in litt. and pers. comm.) and from Benzinger's reports to the state agency.

In recent years, the Cerulean Warbler is a common breeder along the Delaware River, which divides this State from Pennsylvania (Map 20). From the Delaware Gap north to Port Jervis, NY, the Cerulean Warbler is found along the riparian corridor of the Delaware River. The birds tend to use mature deciduous stands of oaks, tulip poplar and sycamores as their prime habitat. The density of Cerulean Warbler along the Delaware River is impressive, with singing males found within several hundred feet of each other.

An extension of the Delaware River population has colonized the Stokes State Forest, High Point State Park, the Flatbrook-Roy Wildlife Management Area, and the Walpack Wildlife Management Area. Often the Cerulean Warblers carve their territories adjacent to or in the vicinity of lakes such as Sawmill Lake at High Point State Park and ponds created by beaver activity. Despite the presence of extensive forests, the Cerulean Warbler has a lower density in these highlands than in the Delaware River corridor.

The Cerulean Warbler also occurs in isolated spots in forested dry ridgetops, often associated with a forest openings. This habitat preference is infrequently used, with occurrences usually consisting of 2–3 singing males in close proximity of each other, but more scattered from each other than habitat used along riparian corridors. Site fidelity is questionable since an occupied site may be used one or two years and then go unused in subsequent years.

In the Highlands physiographic province of New Jersey, the Cerulean Warbler has always been an uncommon breeder along small rivers and streams and to a



Map 20. Cerulean Warbler populations in New Jersey. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

lesser extent on dry ridgetops. Small colonies composed of 2–3 singing males were the most common encounter. Some sites like Dunker Pond in the Newark Watershed and the Rockaway River in the Jersey City Watershed held small colonies for years during the 1980s. Today, the Cerulean Warbler is fast disappearing as a breeder in the Highlands despite plenty of extensive forests, with patch sizes up to 6,000 acres. The increased rarity results in occurrences limited to single birds or pairs in isolated areas and far from other known breeding sites. The Cerulean Warbler has the greatest concentration in the Highlands on Hamburg Mountain ridge of Vernon and Hardyston townships. Occurring in dry ridgetops near small lakes and ponds and along small streams, the Cerulean Warbler is found in locally dense colonies; sometimes 5-6 pairs can be found in a 1/2 mile stretch of stream or woods road. They are found in small openings of the canopy or in dense stands of primarily deciduous trees such as maples, tulip poplars, and oaks. The greatest concentrations occurs in the more remote areas of Hamburg Mountain far from forest edges and seemingly preferring deep forest interiors. An estimated 25–30 pairs can be found on Hamburg Mountain.

Additional surveys in the northern Highlands region by Benzinger and Miranda specifically targeted previously known sites and documented their recent disappearance or rarity. Locations of former occurrence include Ringwood State Park, Greenwood Lake, Canistear Reservoir, Dunker Pond, and Saffin Pond. Areas further east, especially adjacent to the Sterling Forest on the NY border, need to be more thoroughly searched in the near future.

South of the Delaware Water Gap and Northern Highlands, Cerulean Warblers occur in a few, isolated small populations. Most notable of these are the birds at Bulls Island State Park, which occupy mature sycamore forest in the Delaware River. Small numbers were also found in the vicinity of Jenny Jump and Allamuchy Mountain State forests, including along Shades of Death Rd. (Warren Co.) and the Pequest River near Tranquility (Table 12).

Benzinger noted the overall bimodal distribution of Cerulean Warbler habitats in New Jersey, as in other northeastern states. Roughly half of all individuals found were associated with strips of riparian forest along the Delaware river, Big Flatbrook Creek, or other major tributaries (Figure 20). Although CEWAP tree data were not provided from specific sites, these riparian forests are dominated by mature American sycamores. The other habitat most frequently used was upland forest on slopes and ridgetops, dominated either by mesic mixed oak forest or drier oak-hickory forests. As elsewhere in the region, various oaks (especially red oak and white oak), maples (especially red maple), white ash, and tulip tree are dominant trees at occupied sites. It is likely that high numbers of Ceruleans in the uplands of the Kittatinny Mountains results from their close proximity to the Delaware River—similar upland and streamside habitats farther east are unoccupied.

Benzinger further notes the propensity for Cerulean Warblers to occur at or near forest edges, especially near ponds, swamps, or at the border between a forested slope and non-forested river valley. Along the Delaware River, birds were sometimes observed in open-canopied

Table 12. Important areas for breeding Cerulean Warblers in New Jersey.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
40	High Point State Park, Stokes State Forest	Sussex	Dry ridgetop, upland forest	1300–1500
30	Worthington State Forest to Millbrook (Del. Water Gap)	Warren	Riparian, mesic slope	100–500
25–30	Hamburg Mountain and vicinity	Sussex	Dry slope, lake margin	1300–1500
20	Delaware River—Old Mine Rd.	Sussex	Riparian, mesic slope	200–500
12	Bull's Island State Park	Hunterdon	Riparian, river island	75-100
10	Wallpack WMA, Big Flatbrook Creek	Sussex	Riparian, mesic slope	200–500
5	Jenny Jump State Forest, Shades of Death Rd.	Warren	Upland forest	??
3	Pequest River, Tranquility	Warren	Riparian	850
2	Wanaque Wildlife Management Area	Passaic	Upland forest	1300
5	Allamuchy Mountain State Park	Warren, Sussex	Upland forest	900–1000
5	Wawayanda State Park	Sussex	Upland forest	1100–1500

patches, the apparent sites of abandoned homesteads or farms. Furthermore, several occupied areas along the Delaware represented forest strips within grassland or shrubland habitat, suggesting that structure of the forest canopy was more important than extent of habitat patches in this region. Virtually all occupied sites were in forest with canopy height > 15m.

At present, the vast majority of Cerulean Warblers in NJ are on public lands, both state and federally owned. Although these areas are under protection from largescale disturbance, specific management guidelines for Cerulean Warblers do not exist, and important habitats (e.g. strips of riparian forest) are potentially vulnerable to recreational development. An important exception is in the Northern Highlands region, where most birds occur on private land. In particular, the largest remaining population on Hamburg Mountain is currently threatened by development (Miranda).

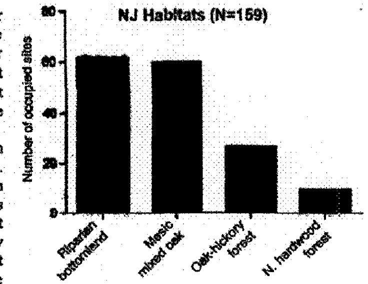


***Figure 20.** Habitat classifications at sites with Cerulean Warblers in New Jersey. "N" equals number of occupied sites with habitat data reported by CEWAP participants.*

New York

The *Atlas of Breeding Birds in New York State* (Andrle and Carrol 1988) reported Cerulean Warblers from 279 (5%) atlas blocks statewide. The bulk of the distribution was reported from the Lake Ontario Plain, with scattered populations south into the Finger Lakes, along the Southern Tier, and in the Hudson Valley and Highlands. Aadrie and Carrol, as well as Bull (1974) discuss the separate expansions of Cerulean Warblers into New York from the Great Lakes to the west, and from New Jersey and Pennsylvania to the south.

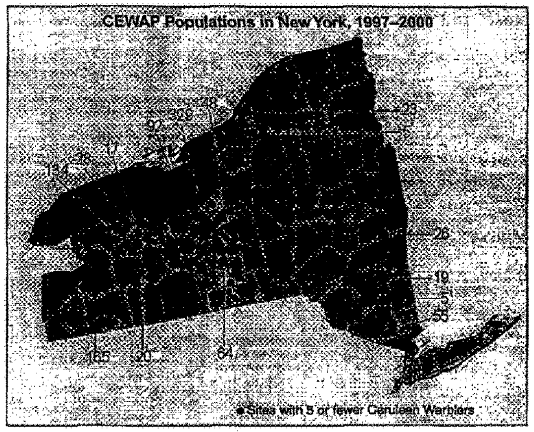
CEWAP participants documented 1,086 Cerulean Warblers at 246 (86%) of 286 sites surveyed in New York State (Map 21). Several areas proved to be important; however, four stand out because of exceptional numbers of birds. These include: the Montezuma National Wildlife Refuge in Wayne, Seneca, and Cayuga counties; the Alleghany River-Salamanca region in Cattaraugus County; the Galen Wildlife Management Area in Wayne County; and the Iroquois National Wildlife Refuge/Orchard Oak Wildlife Management Area in Genesee and Orleans counties. Combined, these four areas accounted for 626 (58%) of the Cerulean Warblers counted in the state (Table 13). Other important areas included several sites in the Hudson Highlands of southeastern New York and Salmon Creek near Cayuga Lake.

Of 240 sites where habitat data were reported, 184 (77%) were classified as bottomland/riparian. These bottomland/riparian sites accounted for 773 (74%) of the Cerulean Warblers observed. Forty-six sites were classified as dry slopes, accounting for 222 (21%) cerulean observations (Figure 21).

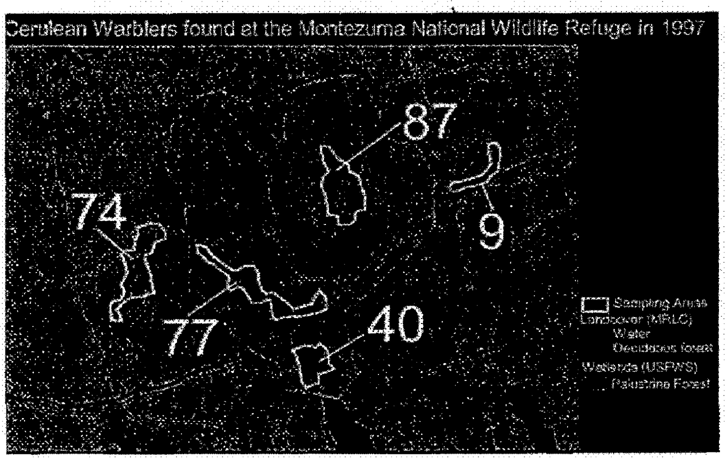
For 215 sites reporting tree species, the most commonly reported trees included maples, cottonwood, and oaks. Other important tree species at occupied sites included ash, American basswood, hickories, American beech, black locust, and sycamore (Figure 22). In a breakdown by region of the state, bottomland sites in the Montezuma and Iroquois region were dominated by cottonwood, silver and red maple, sycamore, and green ash. Sites in the Hudson Highlands were primarily white oak, American beech, sycamore, and ash, whereas sites along the Hudson River were predominantly cottonwood and sycamore. Sites in the Allegany region were dominated by white oak, red oak, chestnut oak, sugar maple, black cherry, and white ash. Cerulean habitat along Salmon Creek in Tompkins County consisted of a diverse forest with sycamores, cottonwood, and black locust in the floodplain and red oak, basswood, and maples on the surrounding slopes.

Most of the Cerulean Warblers in New York occur on publicly owned lands, with the largest populations on National Wildlife Refuges, State Parks, and State Wildlife Management Areas. An important exception is the Salmon Creek population, which exists entirely on private lands. Following initial CEWAP surveys; however, the local Finger Lakes Land Trust became interested in this site and has subsequently acquired several sections of prime Cerulean habitat from willing sellers The National Audubon Society of New York contributed to the conservation of this site by designating it an Important Bird Area and providing support to the Land Trust. Nearly every site with breeding Cerulean War-

(Continued on page 34)



Map 21. Cerulean Warbler populations in New York. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.



Map 22. Cerulean Warbler populations at Montezuma National Wildlife Refuge.

blers in New York State has been designated as an Important Bird Area (Wells 1998).

Montezuma Wetlands Complex. Probably the most complete surveys were conducted on and near the Montezuma National Wildlife Refuge in central NY (Map 22). Bill Evans surveyed most natural and artificial waterways by canoe, sampling a majority of the taller forested wetlands in the region. The 420± males found were concentrated largely in four areas, three of which lie within the USFWS acquisition area for the Montezuma wetlands complex (outlined in light blue on Map 4). The largest number (87 males) was found at Howland Island Wildlife Management Area, 77 males were found in a band from Mays Point Pool area westward, and 40 birds were in the Mud Lock area south of Rt. 20 and around Montezuma NWR headquarters. Note that the westernmost site, with 74 Ceruleans, is the Galen Wildlife Management Area, a state owned tract of similar habitat along the Clyde River. A few additional birds were found eastward along the Seneca River.

Table 13. Important areas for breeding Cerulean Warblers in New York.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
325	Montezuma wetlands complex	Wayne, Seneca, Cayuga	Bottomland, riparian	??
116	Alleghany River-Salamanca region	Cattaraugus	Riparian, dry slope	1350–2200
95	Galen Wildlife Management Area	Wayne	Riparian	??
90	Iroquois NWR, Oak Orchard WMA, and vicinity	Genesee, Orleans	Riparian, swamp forest	630
63	Salmon Creek	Tompkins	Riparian, mesic slope	??
51	Allegany State Park and vicinity	Cattaraugus	Dry slope	1400–2000
48	Tonawanda Indian Reservation,	Genesee	Riparian, swamp forest	650
33	Bear Mountain State Park	Rockland	Dry slope, bottomland	300–1000
26	Castleton Island State Park	Rensselaer, Greene	Riparian, river island	10
20	Letchworth State Park	Livingston	Riparian	??
20	West Point Military Reservation	Orange	??	??
19	Murray-Hulberton Area	Orleans	Riparian, swamp forest	395
15	Chittenango Creek	Onandaga, Madison	Riparian, swamp forest	385

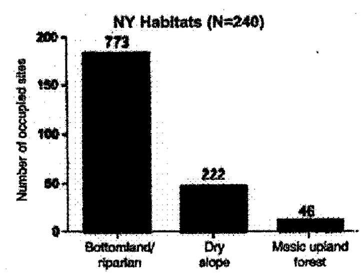


Figure 21. Habitat classifications at sites with Cerulean Warblers in New York. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

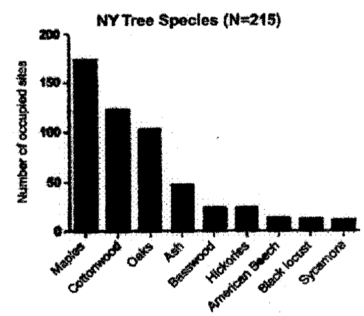


Figure 22. Predominant tree species reported at occupied sites in New York. "N" equals number of sites with tree species reported by CEWAP participants.

Observations of singing birds at Montezuma NWR (N = 235) showed heavy use of red and silver maples (44%), cottonwoods (28%), and ash (16%) (Figure 23).

Concentrations of Cerulean Warblers were all within contiguous blocks of palustrine forest dominated by maples and cottonwoods (shown in magenta within the acquisition area on Map 4). These forests exist primarily along canals and natural channels of the Clyde and Seneca rivers and are often inaccessible except by boat. Areas with many Ceruleans often consisted of unusually large trees, including emergent cottonwoods and swamp white oaks reaching 30 to 40 m in height. Some of these trees undoubtedly date back to the period of barge canal construction in the early 1800s. Average estimated height of trees with singing Ceruleans was 28.3 m (N = 145 trees). Some areas with Ceruleans were in younger forests (especially red maple swamps), but these tended to be adjacent to areas with taller trees. Additional tracts of seemingly suitable habitat, most notably in the Carusoe Lake area, were surveyed but turned up few or no Ceruleans.

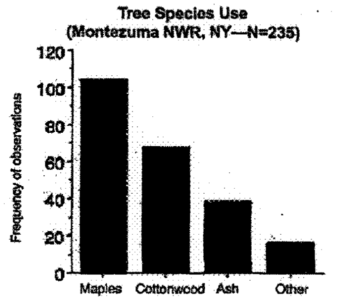


Figure 23. Tree species used by singing Cerulean Warblers in the Montezuma wetlands complex, central NY.

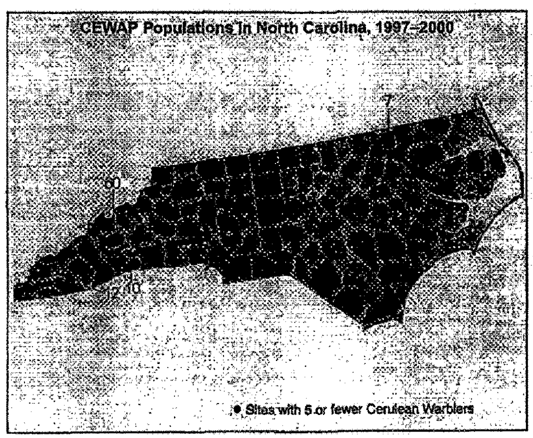
North Carolina

LeGrand (1979) indicates that ceruleans are "rare" and "local summer residents" at lower elevations in mountains and along the Roanoke River in the coastal plain.

CEWAP surveys yielded 109 birds at 39 (93%) of 42 sites (Map 23). By far, the most important site was along the Blue Ridge Parkway in Buncombe County, where 60 (55%) Ceruleans were noted (Table 14). Additional birds were located at other points along the Blue Ridge Parkway, on the Cheoah Ranger District of Nantahalah National Forest, and on White Oak and Warrior Mountains in Polk County. Only 3 birds were located in Great Smoky Mountains National Park. Finally, recent surveys along the Roanoke River revealed 7 Cerulean Warblers.

Of 27 sites reporting habitat data, 13 (50%) were classified as dry slope, while 9 (33%) were in riparian areas. Of the 75 Ceruleans reported from these 27 sites, 53 (71%) were in dry slope habitats, and 11 birds each were in riparian and cove forest habitats (Figure 24).

Upland sites along the Blue Ridge were dominated by oaks (white oak, scarlet oak, chestnut oak), hickories, and tulip tree, whereas riparian forests where Ceruleans occur along the Roanoke River were dominated by sycamore, cottonwood, and green ash (Figure 25).



Map 23. Cerulean Warbler populations in North Carolina. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 14. Important areas for breeding Cerulean Warblers in North Carolina.

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
60	Blue Ridge Parkway, Pisgah National Forest	Buncombe	Dry slope, moist cove forest	3100–3700
10	Cheoah Ranger District, Nantahalah National Forest	Graham	Dry slope, moist cove forest	??
10	White Oak and Warrior Mountains	Polk	??	2000–2400
7	Roanoke River	Halifax, Northampton	Riparian	50
4	Flat River Bluffs	Durham	Riparian	500
3	Blue Ridge Parkway	Ashe	Cove forest	3200
3	Nantahalah Lake, Nantahalah National Forest	Macon	??	??
3	Great Smoky Mountains National Park	Swain, Haywood	??	??
2	Stecoah Gap, Nantahola NF	Graham	Dry slope	3165
2	Chunky Gal Mountain	Clay	??	3400–3800
2	Doughton, U.S. 21	Wilkes	??	??
2	Chimney Rock Park	Rutherford	??	??

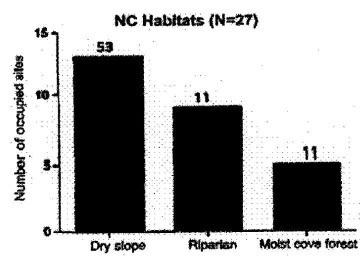


Figure 24. Habitat classifications at sites with Cerulean Warblers in North Carolina. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

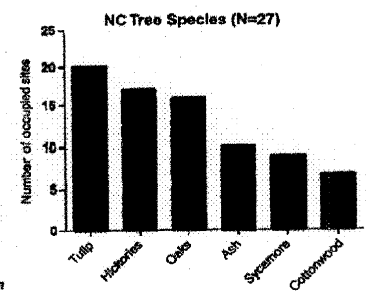
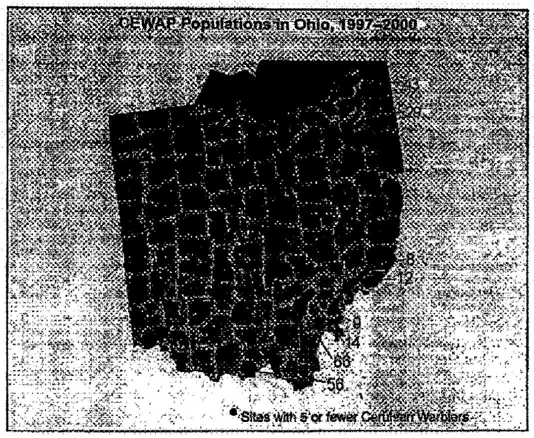


Figure 25. Predominant tree species reported at occupied sites in North Carolina. "N" equals number of sites with tree species reported by CEWAP participants.

Ohio

Hamel (2000) reports the following breeding bird atlas information for Ohio: "Peterjohn and Rice (1991) relate the occurrence and abundance of cerulean warblers in Ohio to the occurrence and abundance of hardwood forests. The birds occurred on 51% of priority blocks statewide. They were very frequent in physiographic areas of the state with relatively large amounts of forest, e.g. 67-89% of blocks in the different portions of the Allegheny Plateau. In the heavily farmed Till and Lake Plain regions, they were encountered in only 21-24% of blocks." CEWAP surveys were concentrated mainly in the northeast and southeast portions of the state.

CEWAP surveys produced 264 Ceruleans at 62 (79%) of 78 sites visited (Map 24). Two of the most important



Map 24. Cerulean Warbler populations in Ohio. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 15. Important areas for breeding Cerulean Warblers in Ohio.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
56	Shawnee State Park and Forest	Scioto	Dry slope, riparian	750–1100
45	Lake Metroparks	Lake	Riparian, dry slope	650–1160
34	Zaleski State Forest/ Lake Hope St. Park	Vinton	Mesic slope, dry slope	??
32	Hewett Fork, Waterloo Township	Athens, Vinton	Dry slope, mesic slope	???
29	Cuyahoga Valley Nat. Recreation Area—Brecksville Reservation—Cleveland Metroparks	Cuyahoga, Summit	Riparian, dry slope	630–650
14	Utah Ridge, Wayne National Forest—Hocking River	Athens	Mesic slope, riparian	??
12	Wayne National Forest—Ludlow, Independence, Lawrence Township	Washington	Dry slope, mesic slope	660–1200
8	Clear Creek Valley	Hocking/Fairfield	Riparian	??
7	Marie J. Desonier State Nature Preserve	Athens	Riparian	??

areas were at opposite ends of the state — the Shawnee State Park and Forest in Scioto County, with 56 birds, and Lake Metroparks in Lake County with 45 birds (Table 15). Numerous other areas in the state also supported moderate numbers of Ceruleans, with a cluster of sites around the Zaloski State Forest in Vinton and Athens Counties supporting 66 birds and several sections of Wayne National Forest reporting at least 26 individuals.

Of 62 sites with known habitat conditions, 27 (43%) were classified as riparian/swamp forest, while 18 (29%) and 17 (27%) were classified as mesic slope and dry slope, respectively (Figure 26).

For 55 sites reporting tree species data, the most common species included oaks, maples, and sycamore (Figure 27). Dry slope habitats in southern Ohio were dominated by chestnut oak, scarlet oak, white oak, and hickories, whereas more mesic upland sites had predominantly white oak, maples, some American beech, and some tulip tree. Riparian sites in northeast Ohio were primarily sycamore forests with some cottonwood, tulip tree, walnut, and maples.

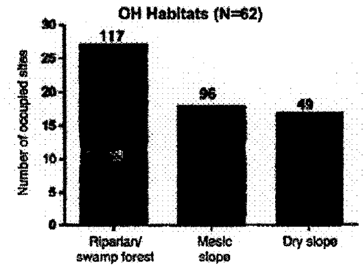


Figure 26. Habitat classifications at sites with Cerulean Warblers in Ohio. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

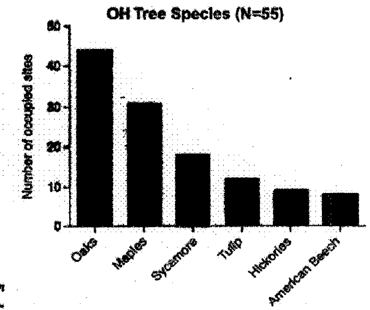


Figure 27. Predominant tree species reported at occupied sites in Ohio. "N" equals number of sites with tree species reported by CEWAP participants.

Pennsylvania

The *Atlas of Breeding Birds in Pennsylvania* (Brauning 1992) reported Cerulean Warblers from 836 (17%) atlas blocks statewide. Ceruleans were reported from nearly every county in the state; however, they were most frequently observed in the southwest corner (Pittsburgh Plateau). CEWAP surveys were focused mainly in the south-central and southwestern portions of the state, with additional coverage along the Delaware River Valley in northeast Pennsylvania.

CEWAP surveys tallied 548 Cerulean Warblers at 182 (89%) of 206 sites visited (Map 25). No single site within the state produced a large number of observations; however, several sites supported more than 25 Ceruleans. These included the Juniata River Valley in Huntington and Blair counties, Delaware River Valley in Pike and Monroe counties, Moraine Sate Park and Jennings Environmental Center in Butler county, and Peter's Mountain State Game Lands in Dauphin County (Table 16). Roughly half of the Ceruleans found were in the Ohio Hills physiographic area of southwestern PA, another 30% were in the Ridge and Valley, and the remainder were scattered through the Allegheny Plateau and Piedmont regions. The Delaware River and adjacent highland population is contiguous with a large population in northwestern New Jersey, and the small population at Allegheny Reservoir is also probably much larger and contiguous with the Alleghany State Park area population in New York. In extreme southeastern Pennsylvania, the small population along White Clay Creek is contiguous with a similar number of birds found in adjacent Delaware. Undoubtedly many more Cerulean Warblers occur throughout Pennsylvania, in areas not searched during CEWAP.

Habitat data were reported for 178 of the Pennsylvania sites. Sixty-eight sites (38%) and 178 individual Cerulean Warblers (33%) were in riparian or other bottomland habitats (Figure 28), with an additional 155 birds (28%) at 57 dry slope or ridgetop sites.

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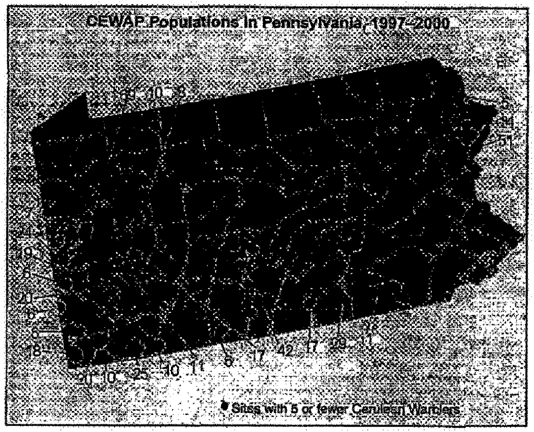

Map 25. Cerulean Warbler populations in Pennsylvania. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 16. Important areas for breeding Cerulean Warblers in Pennsylvania.

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
42	Juniata River and vicinity	Huntington, Blair	Riparian	740–830
40	Delaware River Valley	Pike, Monroe	Riparian, upland	335–990
37	Moraine State Park	Butler	Dry slope, lake margin	1200–1550
32	Jennings Environmental Center	Butler	Dry slope	1220
29	Peter's Mountain and State Game Lands	Dauphin	Dry slope, lake margin	700–1320
23	Brady's Run County Park	Beaver	Dry slope	1000
22	Forbe's State Forest and vicinity	Fayette	Dry slope	1500–2700
20	Duff Park and Boyce Park	Westmoreland	Dry slope, riparian	940–1360
20	Ten Mile Creek and vicinity	NE Greene	Riparian, dry slope	820–1000
19	Sewickley Heights Park	Allegheny	??	900
18	Ryerson Station State Park and vicinity	W Greene	Riparian, upland	1000–1200
17	Michaux State Forest	Adams, Cumberland	Dry slope	1475
15	Crooked Creek Lake Park, Cochran's Mills	Armstrong	Dry slope, riparian	840
14	Delaware State Forest areas	Pike, Monroe	Dry slope	1800–2000
11	Lower Susquehanna River	York	Riparian	225–325
11	Harrison Hills Park	Allegheny	Dry slope	??
10	Ohiopyle State Park and vicinity	Fayette	Dry slope, mesic slope	1950–2135
10	Kinzua Bay, Allegheny Reservoir	Warren, McKean	Dry slope	500
10	Perry, Dunkard Townships	SE Greene	Riparian	1000–1100

39

The most commonly reported tree species at 172 occupied sites included oaks, maples, and sycamore (Figure 29). Riparian sites throughout the state were dominated by sycamores, with black cherry, black locust, tulip tree, white ash, and maples frequently reported. Dry upland sites reported white oak, red oak, black cherry, and maples as the most frequent trees, whereas various combinations of maples, oaks, tulip tree, and cherry predominated at mesic upland sites.

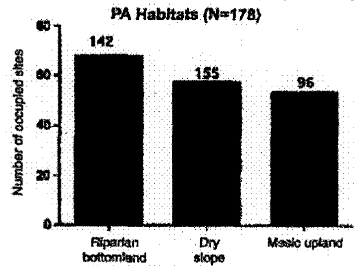

Figure 28. Habitat classifications at sites with Cerulean Warblers in Pennsylvania. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

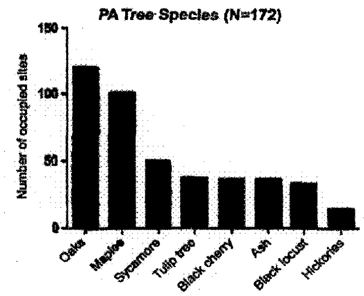

Figure 29. Predominant tree species reported at occupied sites in Pennsylvania. "N" equals number of sites with tree species reported by CEWAP participants.

Rhode Island

No birds observed.

South Dakota

CEWAP participants observed 3 ceruleans at two locations in South Dakota. Two birds were noted at Newton Hills State Park in Lincoln County and 1 bird was observed at Wuabay National Wildlife Refuge in Day County. The Newton Hills Park birds were in 100-ft. canopy riparian forest dominated by cottonwood, silver maple, elm, and ash, whereas the Wuabay NWR bird was in swamp forest of oaks, basswood, and elm.

Tennessee

The *Atlas of Breeding Birds of Tennessee* (Nicholson 1997) reported Cerulean Warblers from 14% of "priority atlas blocks" statewide. Much of our data from Tennessee was provided by Melinda Welton of The Nature Conservancy who coordinated intensive surveys of several portions of the state. CEWAP surveys yielded 1,210 birds at 485 sites (Map 26).

By far the most important region in the state for Ceruleans is the Cumberland Mountains of Campbell, Scott, and Morgan Counties, northwest of Knoxville. In particular, the Royal Blue Wildlife Management Area (42,000 ac) supports at least 430 birds and Frozen Head State Park (8,000 ac) and vicinity supports at least 142 birds (Table 17); these represent the only two areas of publicly owned lands within this large mountainous region. Undoubtedly, many more Ceruleans occur on private lands not surveyed. Birds in this area were found in mesic upland forest dominated by oaks, hickories, and tulip poplar, mostly between 2,000 ft. and 3,000 ft. elevations.

Another very important area is the Center Hill Lake region of DeKalb and Putnam Counties in central Tennessee. In this area, most Ceruleans were found along the more-forested northern shore and surrounding hills, including Edgar Evins State Park, Floating Mill, and Mine Lick Creek. A significant but unknown proportion of these birds were on public recreation area land owned by the Army Corps of Engineers. In summer 2000, an additional 34 birds were located on the escarpment further north in Putnam County. These latter individuals were in relatively young forest, where taller tulip poplars formed an uneven emergent canopy (Welton, pers. comm.).

(Continued on page 42)

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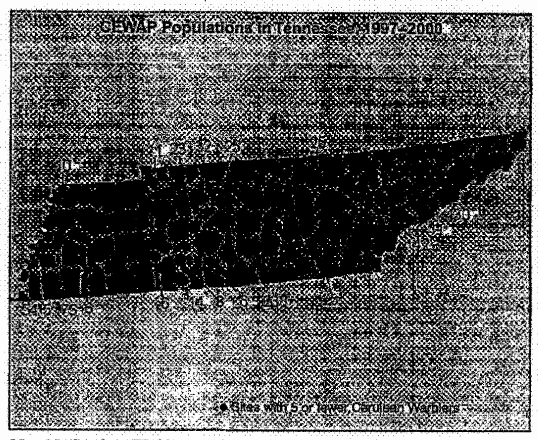


Map 26. Cerulean Warbler populations in Tennessee. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 17. Important areas for breeding Cerulean Warblers in Tennessee.

Number of birds	Site location	County (s)	Habitat (s)	Elevation (ft)
430	Royal Blue Wildlife Management Area and vicinity	Campbell, Scott	Mesic slope	2000
142	Frozen Head State Park and vicinity	Morgan, Scott	Mesic slope	2100–3200
238	Center Hill Lake, Edgar Evins State Park and vicinity	DeKalb, Putnam	Mesic slope, dry slope	800–900
75	Chickasaw National Wildlife Refuge	Lauderdale	Riparian, swamp forest	240–250
54	Meeman-Shelby Forest State Park, Mississippi Delta	Shelby	Upland, bottomland	240-300
32	Cheatham Wildlife Management Area	Cheatham	Dry slope, mesic slope	500–725
28	Natchez Trace Parkway, National Park	Williamson	Dry slope, mesic slope	865–900
25	Mill Creek Rd.	Putnam	Dry slope	1100–1350
15	Reelfoot National Wildlife Refuge	Hayward, Obion	Bottomland	290
12	Bear Knob	Overton	Dry slope	1360
11	Westvaco Timberlands	Stewart	Dry slope, mesic slope	475–600

A third important region of the state for Cerulean Warblers is along the Mississippi River, where relatively large numbers were found at Chickasaw National Wildlife Refuge (75 birds) and Meeman-Shelby Forest State Park north of Memphis (54 birds). Birds at Chickasaw NWR occupied bottomland hardwood forest dominated by cottonwoods. Additional individuals were found on bluffs along the Mississippi River at Fort Pillow State Park.

Overall in Tennessee, nearly 400 of the 467 sites with reported habitat conditions were classified as mesic slope (Figure 30). These 400 sites accounted for 65% of Cerulean observations, whereas dry slopes supported 20% and riparian/bottomland habitats accounted for the remaining 13%.

For 87 sites where tree species data were reported, the most frequently observed species included oaks (mostly white oak and scarlet oak), hickories, and tulip poplar (Figure 31). Bottomland hardwood sites were dominated by cottonwood, American sycamore, and tulip-poplar.

The Cerulean Warbler population in the Northern Cumberland Plateau region of Tennessee represents the single largest concentration of this species reported from anywhere within it's range (see Table 1). Even though many of these birds are on state-owned land, Melinda Welton reports potential threats from surface mining in this area. Royal Blue is a 42,000 acre Wildlife Management Area owned and managed by the Tennessee Wildlife Resources Agency. Tennessee Valley Authority (TVA), however, owns the surface mineral rights to this land and is currently exercising those rights. A mining permit was issued in September 1999 that would directly impact 600 acres. A 100 acre clearcut in preparation for mining was completed in September 2000. Discussions with TVA are currently underway concerning the advisability of proceeding with this mining permit and future permits on Royal Blue. The future of Cerulean Warblers on vast acreages of private land, such as large areas owned by Champion-International, are even more uncertain.

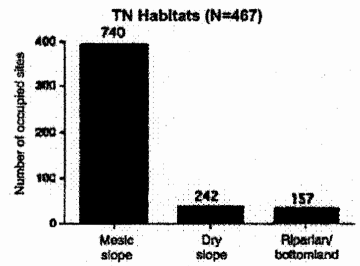


Figure 30. Habitat classifications at sites with Cerulean Warblers in Tennessee. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

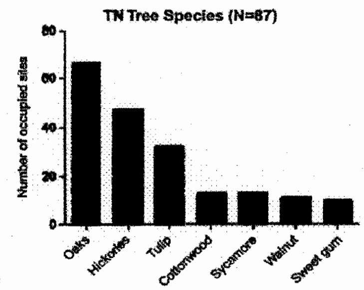


Figure 31. Predominant tree species reported at occupied sites in Tennessee. "N" equals number of sites with tree species reported by CEWAP participants.

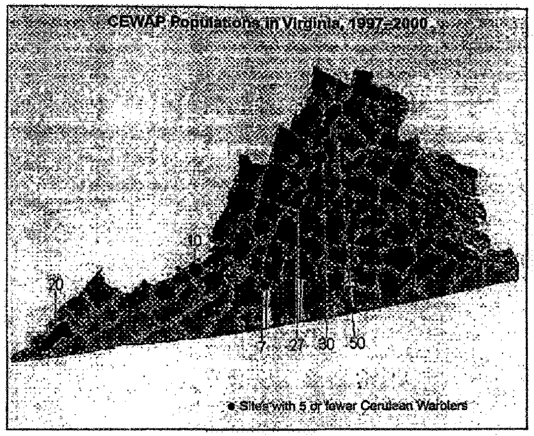
Virginia

The *Virginia Breeding Bird Atlas Project* recorded Cerulean Warblers on 88 blocks primarily in the western and northern mountains, and Shenandoah Valley.

CEWAP participants documented 152 birds on 64 (61%) of 106 sites visited (Map 27). A majority of birds found were clustered in three portions of the Blue Ridge — the Pocosin Cabin area of Shenandoah National Park with 30 Ceruleans, the Reeds Gap-Humpback Mountain area with 27 birds, and the north section of Shenandoah National Park and Appalachian Trail north of U.S. Highway 522 with a total of 44 Ceruleans detected (Table 18). An additional 20 Ceruleans are estimated to occur on the Clinch Ranger District of Jefferson National Forest in extreme western Virginia. Undoubtedly many more Cerulean Warblers occur in unsurveyed portions of the Northern Cumberland Plateau and on the Ridges west of Shenandoah Valley.

For 60 sites with reported habitat conditions, 41 (68%) were classified as mesic cove forest and 18 (30%) dry slope. Mesic cove forests supported 67 (46%) Ceruleans while dry slope forests supported 78 (53%) (Figure 32). The only birds found away from the mountain ridges were two individuals at Riverbend Park on the Potomac River, in cottonwood-silver maple-boxelder forest.

For 61 sites where tree species data were reported, the most commonly recorded species were oaks (mostly northern red oak, chestnut oak and white oak), maples (mostly red maple), and hickories (shagbark and mountain hickory), with tulip tree, white ash, and black locust also frequently reported (Figure 33).



Map 27. Cerulean Warbler populations in Virginia. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 18. Important areas for breeding Cerulean Warblers in Virginia.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
30	Shenendoah National Park—Pocosin Cabin Area	Greene	Dry slope	2700–3200
29	Appalachian Trail, N. of US Highway 522	Warren	Mesic cove forest	1200-2000
27	Blue Ridge Parkway—Reeds Gap, Humpback Mtn. Area	Augusta, Nelson	Dry slope	2332–3600
20	Clinch Ranger District, Jefferson National Forest	Lee, Scott, Wise	Dry slope, cove forest	2420–3370
15	Shenendoah National Park—north section	Warren, Rappahannock	Dry slope, cove forest	1950–2800
10	Doe Creek area—Rt. 613	Giles	Dry slope	3100-3400
7	Blue Ridge Parkway, Flat Top Mountain (Jefferson NF)	Bedford	Mesic cove forest	2610–2700
2	Riverbend Park	Fairfax	Riparian	160

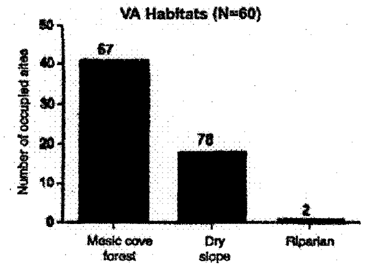


Figure 32. Habitat classifications at sites with Cerulean Warblers in Virginia. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants

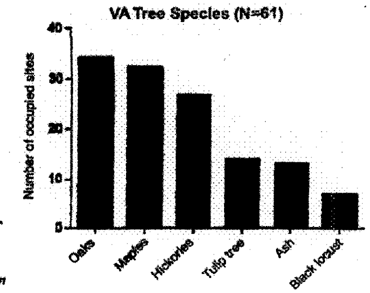
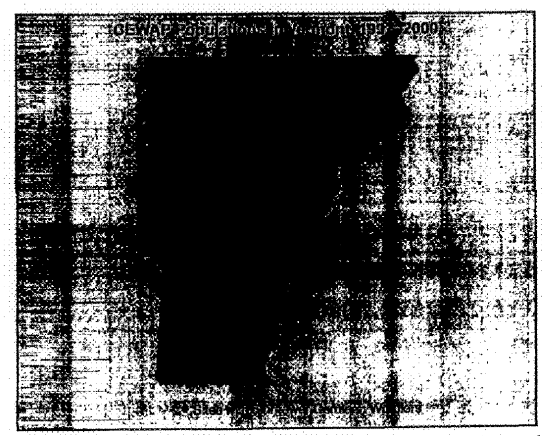


Figure 33. Predominant tree species reported at occupied sites in Virginia. "N" equals number of sites with tree species reported by CEWAP participants.

Vermont

The *Atlas of Breeding Birds of Vermont* (Ellison 1985) reported Ceruleans from only two atlas blocks statewide.

CEWAP participants observed only 1 individual on 1 of 3 sites visited in 1997 and 1998. The bird was observed along the Lamoille River near the town of Milton in Chittenden County. In summer 2000, however, the previously vacant site near the Quebec border had a singing Cerulean Warbler, and a third location was obtained via Chris Rimmer through the Vermont birding listserve. All known sites in the state are along the east shore of Lake Champlain (Map 28).

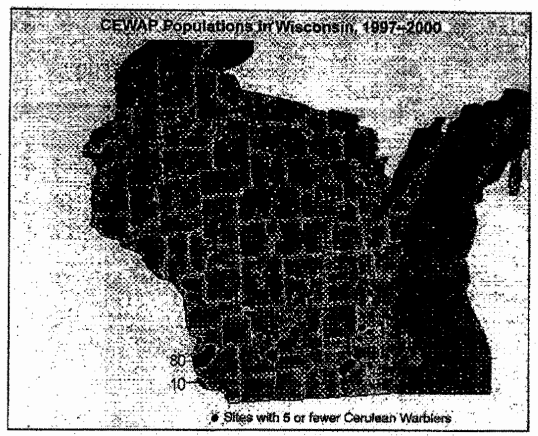


Map 28. Cerulean Warbler populations in Vermont. Polygons represent clusters of sites where ceruleans were found in close geographic proximity.

Wisconsin

Hamel 2000 reports the following regarding the Wisconsin Breeding Bird Atlas: "Breeding Cerulean Warblers recorded as confirmed, probable, or possible in 3.8% of 3,084 blocks (5 km x 5 km each) surveyed throughout the state, with most birds being found in the southern half of the state in upland hardwood oak-hickory or maple-beech-birch forests (Jennifer Davis, 15 March 2000, pers. comm. to Stephen Lewis)." CEWAP surveys were concentrated in the southern one-third of the state, however, Ceruleans were also noted in the west-central and northeast portions of the state.

CEWAP participants tallied 174 Ceruleans at 59 (98%) of 60 sites surveyed (Map 29). Three sites supported more than 20 birds each—the Lower Wisconsin River and Wyalusing State Park in Grant County, and Lake LaGrange in Walworth County (Table 19). Sixteen additional birds were found in the Lower Kickapoo River area, just to the north of the Wisconsin River.



Map 29. Cerulean Warbler populations in Wisconsin. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

Table 19. Important areas for breeding Cerulean Warblers in Wisconsin.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
31	Lower Wisconsin River	Grant	Riparian, mesic slope	620-740
24	Wyalusing State Park	Grant	Dry slope, mesic slope	650-1150
20	Lake LaGrange	Walworth	Mesic slope	885-1000
16	Lower Kickapoo River Valley	Crawford	Riparian, mesic slope	690-900
8	Kettle Moraine State Forest	Jefferson	Dry slope	880-890
8	Nelson Dewey State Park	Grant	Riparian	900
6	Blue Mounds State Park and vicinity	Iowa, Dane	Mesic slope	1100-1400
5	Plum Creek	Pierce	Mesic slope	840-900
4	Kinnickinnic State Park	Pierce	Bottomland	900
4	Goat Ranch Rd.	Eau Claire	Mesic forest	1000

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Of 56 sites with reported habitat conditions, over half were classified as mesic upland forest, which accounted for 104 (56%) of the Ceruleans observed (Figure 34). The 20 bottomland riparian sites supported 53 (31%) birds.

For 56 sites with known tree species, the most common trees were oaks, maples, and hickories (Figure 35). Black Walnut and basswood also were frequently reported, and bottomland riparian sites often had cottonwoods and elms.

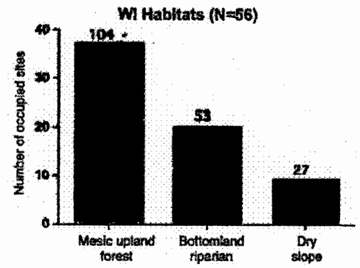

Figure 34. Habitat classifications at sites with Cerulean Warblers in Wisconsin. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

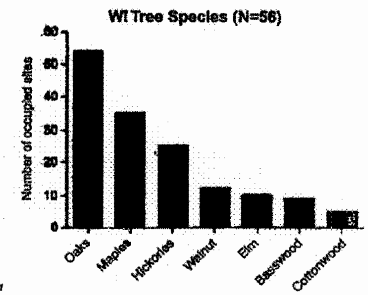

Figure 35. Predominant tree species reported at occupied sites in Wisconsin. "N" equals number of sites with tree species reported by CEWAP participants.

West Virginia

Hamel (2000) reports the following for West Virginia: "Atlas work shows the birds to be widespread and common in the Western Hills, scarce or missing in the Allegheny Mountains Region, and to occur sparingly the Ridge and Valley Region. In the Ridge and Valley Region of West Virginia, the birds are limited to river valleys. Birds were recorded on 258 blocks in West Virginia (Buckelew and Hall 1994)."

CEWAP coverage was extensive in West Virginia with sites located in most counties (Map 30). A particular effort was made to survey state-owned parks and wildlife management areas, under the supervision of Drew Jones at the West Virginia Department of Natural Resources. Even so, vast areas went unsearched, and total Cerulean Warbler populations are very difficult to determine.

In West Virginia, 1,124 ceruleans were reported from 254 (74%) of 345 sites surveyed during CEWAP. Numerous sites supported more than 20 birds, with the most populated sites being the New River Gorge and Garden Ground Mountain area with 94 Ceruleans found, Kanawha State Forest with 78 birds, Guyandotte Mountain and vicinity with 78 birds, and Louis Wetzel Wildlife Management Area with 65 birds (Table 20). Cerulean Warblers were most widely distributed throughout the Ohio Hills physiographic area, with smaller populations scattered through the Ridge and Valley. They were rarely found in the large forested regions of the Allegheny Mountains, such as on the Monongahela National Forest. Coverage was poor in the Cumberland Plateau region (no sites surveyed in Mingo County) and in the Panhandle region.

A significant portion of the Ceruleans found in West Virginia were on the many state-owned lands that were surveyed. In all 28 tracts of state land supported 456 singing male Ceruleans. Although this may be a small fraction of the total state population, it may represent a reasonable estimate of the number of birds under potential management or protection by the state of West Virginia. Besides the Kanawha State Forest and Louis Wetzel WMA, important state lands include Beech Fork State Park (50 pairs), Cooper Rock State Forest (23 pairs), and Ritchie Mines WMA (22 pairs).

More than half of the sites reporting habitat data were classified as dry slope/ridgetop (Figure 36). The dry slope/ridgetop sites accounted for 700 (65%) cerulean sightings. The remaining 35% of sites were nearly equally divided between moist slope/cove habitats and bottomland/riparian habitats.

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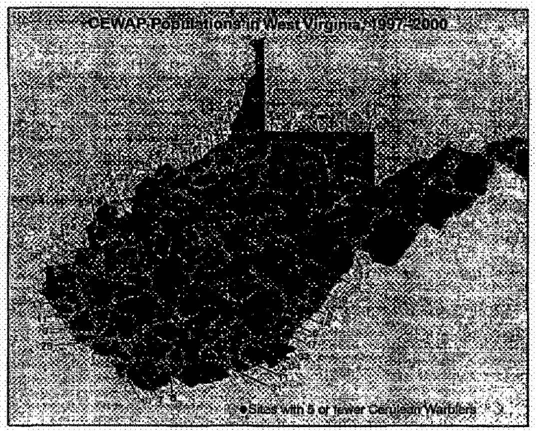

Map 30. Cerulean Warbler populations in West Virginia. Polygons represent clusters of sites where ceruleans were found in close geographic proximity. These do not necessarily match specific areas listed in the corresponding state table.

The primary tree species noted on 221 occupied sites statewide were oaks, maples, hickories, and tulip tree (Figure 37). Forests with Cerulean Warblers were extremely diverse. At riparian sites, sycamores were dominant, with cottonwoods, white oak, red oak, various maples, boxelder, tulip tree, and black locust also frequently reported. Dry slopes and ridgetops were dominated by white oak, red oak, scarlet oak, chestnut oak, shagbark, mountain, and pignut hickories, and red maple, whereas mesic slopes and cove forests were dominated by white oak, red oak, sugar maple, tulip tree, with American beech, basswood, and black cherry also common (Figure 37).

In West Virginia, our field assistants also collected detailed data on tree-species use by foraging or singing Cerulean Warblers in 1997. Observations of foraging and singing birds at upland sites (N = 150) indicated frequent use (10-17%) of chestnut oak, red oak, maples, hickories, and white oak, with lesser use of tulip tree, black oak, and 11 other tree species (Figure 38).

Table 20. Important areas for breeding Cerulean Warblers in West Virginia.

Number of birds	*Site location*	*County (s)*	*Habitat (s)*	*Elevation (ft)*
94	New River Gorge— Garden Ground Mountain Area	Fayette, Raleigh	Dry slope, riparian	1330–3000
78	Kanawha State Forest	Kanawha	Mesic cove forest, dry slope, riparian	800–1500
78	Guyandotte Mountain and vicinity	Raleigh, Boone, Wyoming	Upland forest	2500–3230
65	Louis Wetzel WMA	Wetzel	Dry slope, riparian	823–1500
50	Beech Fork State Park	Wayne	Lake margin, dry slope	625–940
50	North Bend State Park and Rail Trail, Mountwood Park	Ritchie, Wood	Dry slope, cove forest, riparian	700–1110
40	Greenbrier River drainage and adjacent mountains	Greenbrier	Dry slopes	2100–3500
36	Fork Creek WMA— Little Coal River and vicinity	Boone, Lincoln, Kanawha	Riparian, mesic slope	875–1130
28	Murphy Preserve	Ritchie	Moist cove forest, dry slope, riparian	900–1085
23	Coopers Rock State Forest	Preston, Monongalia	Mesic slope, dry ridgetop	2060–2280
22	Ritchie Mines WMA	Ritchie	Dry slope	1000–1120
19	Dutch Ridge	Klanawha, Clay	Dry slope	1150
18	Stupton WMA	Calhoun, Gilmer	Dry slope	900–1000
18	Maxwell Ridge	Doddridge	Dry slope	1250
17	Wallback WMA	Kanawha	Riparian, dry slope	640–1100
16	Sand Hill WMA	Wood, Ritchie	Dry slope, mesic slope	1100–1300
14	Rowlesburg	Tunnelton	Dry slope, bottomland	1525–2100
14	Cedar Creek State Park	Gilmer	Dry slope	750–1225
13	Amherst—Plymouth WMA	Putnam	Riparian, mesic slope, dry ridgetop	560–1000
13	Rowlesburg—Laurel Mountain	Preston	Dry slope, bottomland	1440–2100
12	Mud River	Boone	Riparian, moist cove forest	750
11	McDonough	Wood	Dry slope, mesic slope	700–820
11	Bluestone State Park	Summers	Riparian	2200
10	Panther State Forest	McDowell	Upland forest	??
10	Nathaniel Mountain	Hampshire	Dry slope	2600–3000

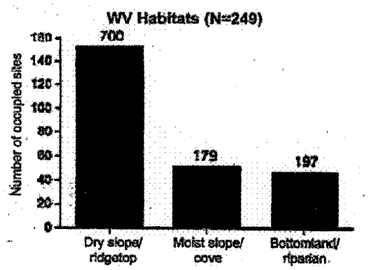

Figure 36. Habitat classifications at sites with Cerulean Warblers in West Virginia. Numbers of individual Cerulean Warblers recorded in each habitat type are noted above the bars. "N" equals number of occupied sites with habitat data reported by CEWAP participants.

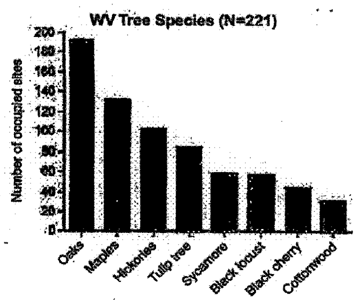

Figure 37. Predominant tree species reported at occupied sites in West Virginia. "N" equals number of sites with tree species reported by CEWAP participants.

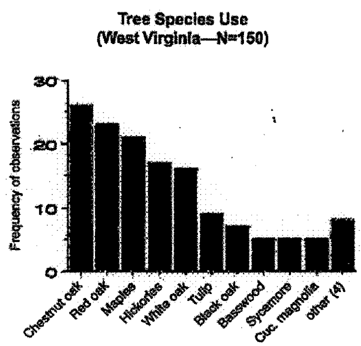

Figure 38. Trees species used by Cerulean Warblers for foraging and singing at upland sites in West Virginia.

DISCUSSION AND CONCLUSIONS

The Cerulean Warbler Atlas Project produced a list of several hundred sites that are important to this species in every state throughout its range. Although these represent a critical first step in conserving key populations of Cerulean Warblers in each region, coverage and completeness of the atlas surveys was highly variable in different parts of the species' range. In general, coverage near the edge of the Cerulean's range was probably most complete and accurate. For example, it is likely that most of the existing populations and sites were identified in New England, New Jersey, most of New York, Illinois, Alabama, Georgia, and Minnesota. In contrast, sites identified in West Virginia, Pennsylvania, Ohio, Kentucky, and much of Tennessee most likely represent only a small fraction of the populations that actually exist in these states. It is extremely difficult for us to assess the completeness of CEWAP in most states without much further fieldwork and consultation with local experts.

To compare with numbers of birds found by CEWAP participants, very crude estimates of Cerulean Warbler total populations can be calculated from Breeding Bird Survey relative abundances in each physiographic area. The BBS may provide landscape-level density estimates that can be converted into regional population estimates if the following assumptions are made:

1. BBS routes constitute a random sample of the landscape;
2. habitats in question are fairly evenly distributed across the region; and
3. each bird species has a relatively fixed average detection distance at BBS stops, within which a reasonable estimate of the number of individuals present may be obtained.

An entire BBS route composed of 50 stops, each consisting of a 0.25 mi. (400 m)-radius circular count, potentially surveys roughly 25 km^2 of heterogeneous landscape. Based on a study by Emlen and DeJong (1981), we may estimate the average maximum detection distance for typical forest birds to be roughly 125 m—for these species a BBS route samples an effective area of 2.5 km^2. If Cerulean Warblers are detected routinely out to 200 m at each stop, the effective area surveyed is increased to 6.3 km^2.

Population estimates for a physiographic area are then calculated as the average landscape-level density (number of birds per route * effective area sampled by each route) multiplied by the size (km^2) of the physiographic area. Note that landscape-level densities are not assumed to be similar to species densities in uniform optimum habitats, but rather reflect habitat heterogeneity at larger scales as sampled by BBS routes. Because the great majority of detections on typical BBS routes are of singing or displaying males, the population estimate derived from this method is assumed to represent numbers of breeding pairs.

Applying this methodology produces a range of estimates for Cerulean Warblers throughout their range that is usually much larger than that detected by CEWAP (Table 21). In fact a global population estimate of 85,000 to 214,000 breeding pairs would indicate that CEWAP found fewer than 10% of existing birds. As expected, the largest proportion of the total population occurs in the Ohio Hills and Northern Cumberland Plateau, where an average of 2 to 3 Cerulean Warblers are detected annually on every BBS route in the last decade. In West Virginia alone, the total population is almost certainly in the 10,000s, and may be close to 100,000 pairs. In physiographic areas near the periphery of the Cerulean's range; however, the number of birds found is not greatly different from that estimated using BBS – for example, Southern New England, Lower Great Lakes Plain.

Our atlas is therefore most valuable in areas away from the center of the species' distribution. Populations and sites identified in most states may serve as the nucleus for a conservation strategy that should include continued monitoring, management, and possible acquisition of currently unprotected sites. In the center of the range, specific sites may also be important for long-term monitoring and to provide a sample of the range of conditions required by this species. Because many sites identified are on public lands, these may also serve as core areas for sustaining regional populations. Where Cerulean Warblers are more continuously distributed and do not lend themselves to a "circles on maps" atlas technique, a modeling approach, taking into account different densities in different habitats, may be necessary to identify the most important areas for sustaining the bulk of the population.

Table 21. Cerulean Warbler populations size estimates for Partners In Flight physiographic areas, based on extrapolations from BBS relative abundance. Range of estimates based on assumptions of effective area covered by each BBS route between 6.3 km^2 and 2.5 km^2.

Physiographic Area Name	*Area #*	*BBS Population Range (pairs)*
South Atlantic Coastal Plain	3	40–100
East Gulf Coastal Plain	4	330–840
Southern New England	9	90–225
Mid-Atlantic Piedmont	10	600–1,500
Mid Atlantic Ridge and Valley	12	2,550–6,400
Southern Ridge and Valley	13	95–240
Interior Low Plateaus	14	7,300–18,500
Lower Great Lakes Plain	15	210–530
Upper Great Lakes Plain	16	360–950
Northern Ridge and Valley	17	2,000–5,200
St. Lawrence Plain	18	150–400
Ozark-Oachita Plateau	19	1,950–4,900
Boreal Hardwood Transition	20	1,850–4,600
Northern Cumberland Plateau	21	22,700–57,200
Ohio Hills	22	37,600–94,700
Southern Blue Ridge	23	1,250–3,100
Allegheny Plateau	24	4,450–11,200
Prairie Penninsula	31	750–1,900
Osage Plains	33	85–210
West Gulf Coastal Plain	42	110–275
Mid Atlantic Coastal Plain	44	25–65

Habitat and Area Reqirements

Primary habitat for this species is most often described as mature deciduous forest, typified by structurally mature hardwood species in mesic or floodplain conditions with a closed or semi-open canopy. Habitat descriptions in the literature often have emphasized moist woodlands in both upland and bottomland forest (e.g. Schorger 1927, DeJong 1976) in different regions. Hamel (2000) summarizes the broad range of habitat descriptions that exist for this species, concluding that Cerulean Warblers may be somewhat opportunistic in seeking the most mature forest conditions available in each region. Dominant tree species and understory species described in the literature also tend to vary by region; tree size is thought to be primary and tree species of secondary importance (Hamel 2000).

Habitat data from CEWAP confirm the wide range of habitat types used by Cerulean Warblers throughout their range. Large populations occur in both riparian bottomland forests and in a variety of upland situations. Perhaps under-appreciated in past accounts is the importance of dry slope and ridgetop habitats to Cerulean Warblers, not only in the Appalachian ridges, but also in New England and the upper Midwest. Although many of these slopes and ridges are in relatively close proximity to major river valleys, suggesting that populations may "spill" up the slopes from the bottomlands, this is not always the case. For example, dry ridges seem to be the primary habitat of this species in many parts of the Blue Ridge of Virginia and North Carolina. The most important feature of this habitat type, perhaps, is the presence of mature oak-hickory forest, with white oak, red oak, black oak, scarlet oak, and chestnut oak frequently mentioned as dominant.

Throughout much of the Southeast and northwards through the Appalachians, a very important habitat for Cerulean Warblers continues to be mesic upland forest, including mixed mesophytic or cove forest. CEWAP confirmed the large populations that occur wherever large tracts of this habitat exist, and also the great diversity of tree species present at these sites. Tulip tree appears to be a common indicator of Cerulean habitat in many of these areas, in addition to the variety of oak species and often maples.

Away from the Appalachian Mountains, a majority of Cerulean Warbler populations seem to occur in mature riparian or other bottomland forests along large or

medium-sized waterways. Only a few pockets of Ceruleans persist in the Mississippi River Valley proper, but a number of tributaries support the bulk of the species in the Midwest Region. Other important riparian areas include the Delaware River Valley, Roanoke River in Virginia, middle Hudson River, and forested wetlands of the Lake Ontario Plain in New York. A common feature of these riparian forests, nearly throughout the range, is the presence of mature stands of sycamores.

Hamel (2000), as well as other authors, have struggled to find a common denominator among the varied descriptions of Cerulean Warbler habitat structure and tree-species use. A tall, but broken, canopy seems to be the most frequently mentioned feature, along with large area requirements. Indeed, a shared feature of the three very different habitat types used by a majority of Cerulean Warblers may be the irregular canopy structure. On dry ridges, tall oaks form a linear "internal edge," where warbler territories may look out over the surrounding canopy. This same linear canopy edge is a prominent feature of mature riparian forests, especially where tall sycamores form an emergent layer above the other trees. On slopes with a diverse mixed mesophytic forest, the presence of trees with a variety of canopy structures is probably key to providing the same sort of canopy-edge effect desired by Cerulean Warblers. Melinda Welton's observation of Ceruleans inhabiting secondary forest patches in Tennessee, where tulip trees form a broken emergent canopy, suggests that this tree may be an important structural ingredient in otherwise closed-canopy oak forests.

Landscape situation and context has a strong bearing on whether otherwise suitable breeding habitat will actually contain warblers (Hamel 1992). Cerulean Warblers are thought to prefer large, contiguous tracts of deciduous forests for breeding (Bond 1957, Hamel 1981, Robbins et al. 1992). Hamel (2000) notes the geographic variation and inconsistency of published references to area sensitivity, however. For example, this species seems to prefer large wooded tracts of at least 50-75 acres, and typically avoids isolated woodlots less than 20-25 acres in size in Ohio (Peterjohn and Rice 1991). In other areas, stands greater than 526 ha (1,300 acres) are considered optimal for Cerulean Warblers (Evans and Fischer 1997).

CEWAP results, although providing only crude estimates of habitat-patch sizes occupied by Cerulean Warblers, do suggest geographic variation in degree of area sensitivity. Whereas a large number of individuals occurred in extensive forest tracts in all regions, the proportion of birds in these large patches varied among the regions. In the Southeast, nearly all birds found were in forests ≥ 1,000 acres, suggesting strong area sensitivity, whereas in the Northeast, a substantial proportion of populations were in much smaller forests. Further defying the conventional wisdom on Cerulean Warblers, a growing body of research in eastern Ontario suggests that birds there thrive in patches of secondary maple forest as small as 25 acres (Jason Jones, pers. comm). Because quantitative studies of area requirements in Cerulean Warbler come primarily from the Mid-Atlantic and southeastern states (Robbins et al. 1989, Hamel 1992), rangewide assumptions of extreme area sensitivity may be exaggerated.

Monitoring and Research Needs

This Atlas of Cerulean Warbler Populations may be considered a first step in identifying the key sites and habitats required to protect this species into the future. For a successful conservation strategy that ensures the maintenance of healthy breeding Cerulean Warbler populations throughout the species' range, we recommend the following monitoring and research components:

- Repeat surveys of the 73 primary and secondary sites identified in Table 1 and 2, perhaps every five years, to monitor health of known, important populations.
- Quantitative studies of reproductive success and population turnover in upland vs. bottomland habitats, specific to each region.
- Quantitative studies of regional area sensitivity, perhaps using GIS analyses of habitat patches identified in CEWAP.
- Habitat suitability modeling to determine new and potential population sites, especially in areas where CEWAP was less effective.
- Quantitative studies of response to management options, such as canopy thinning, selective logging, or wilderness protection.
- Determination of potential threats to important CEWA populations, such as from mountaintop removal mining, residential development, or logging.
- Determine pattern of land-ownerships at important areas in each region: devise alternative strategies for conservation and management on public, vs industrial, vs private lands.

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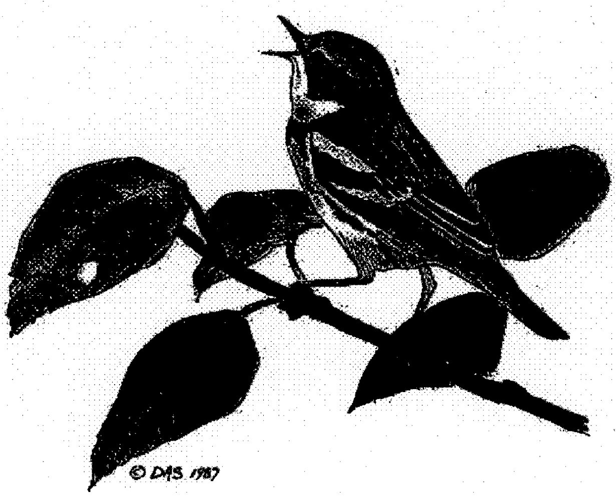

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APPENDIX

Appendix 1. List of CEWAP participants from 1997–2000. The names in bold represent paid field assistants.

Ray Adams
Brian Allen
Steve Allen
Kathleen Anderson
Rod Annelin
Richard Armstrong
James Ash
Jennifer Akin
Fred Atwood
Timothy Baird
Nick Barber
Ken Barmore
G. Beaton
Ralph Bell
John Benzinger
Dan Best
Doug Blatny
Brad Blodget
Susan Boettcher
Nicholas Bolgiano
Darcie Bomkamp
W. Brad Bond
D. Bonter
Aileen Boyd
Patrick Boyd
Dan Brauning
Hunter Brawley
Cindy Breedlove
Matthew Bribitzer-Stull
Joseph Brin
Jeff Buecking
Barbara Butler
Lois Buder
Adam Byrne
Ron Canterbury
Rick Cantu
Jacki Carey
Bernie Carr
Joan Carr
John Cecil
Dexter Chafee
Davis Chapman
Allen Chartier
Dwight & Ann Chasar
John Churchill
Lathe Claflin
Roger Clifford
Mary Clinton
Bruce Cohen
David Corsini
Linda Crabtree
Julie Cravea
Rickie Crone
Ginnie Cronenberger
John Cruzan
Paul Cypher
Darney
Dale Davis
David Davis
Tom Davis
Deana Dawson
Barb Dean
John DeMary
Tom Demeo
Melissa Dennison
Jenny Dickson
Kara Donovan
Carol Doscher
Sam Droege
Douglas Dwyer
Tom Eckert
Jocelyn Elkenburg
Karen Eldestein
Michael Elsea
Russell Emmons
Bill Evans
David Ewert
Bruce Fall
Victor Fazio
Sam Febba
John Fedak
Gary Felton
Bob Ford
Chip Franke
Dick Franz
Carl Freeman
Aaron Gabbe
Natalia Garcia
Paula Gills
Heather Gockley
Charolette Goedsche
Rod Goforth
Michelle Goldsborough
Jim Granlund
Jane Graves
Mark Greene
Ralph Grundell
James Grundy
Carol Guba
Tom Hall
Paul Hamel
Lise Hanners
Nancy Harpie
Bob Hartman
Larry Hedrick
Sheldon Henderson
Joey Herron
Anthony Hertzel
Paul Hess
Michael Hill
Ron Hoff
Karen Holmes
Marjorie Howard
Amy Howe
Dainne Huggelt
Chuck Hunter
Marc Ingramm
Rainy Inman
Harriet Irwin
Venkatesh Iyengar
John Jacobs
Doug James
Bob Janssen
Margaret Jewett
Mark Johns
Drew Jones
Jason Jones
Peter Jones
William Jones
Steven Joule
Steve Kelling
Art Kennell
Terry Kerns
Michael Kielb
C. Lawrence King
Tim Kippenberger
Nathan Klaus
Geo Kloppel
David Knapp
Chris Knoll
Ray Korpi
Yulee Larner
Laurie Larson
Jack Lash
Thomas LeBlanc
Roma Lenehan
Fred Lesher
Josh Lipton
Robert Long
Jim Lowe
Judy Lund
JM Lynch
Glenn Lynn
Smoot Major
Michael Marks
Bill Martinus
May
Mark McConaughy
David McConnell
Vickie McDonald
C. McGrath
Francis McMenemy
John McNeely
Frances McVay
Doug McWhirter
Jerry McWilliams
Peter Mehring
Scott Meier
Mike Menconi
Ken & Cassandra Middleton
Dorothy Miller
Kip Miller
Susan Miller
Dennis Miranda
Donna Mitchell
Laura Mitchell
Nell Moore
Mike Morgante
Eugene Morton
Terry Mosher
Greg Moxhay
James Murphy
Rod Murray
Rich Nicholls
Chuck Nicholson
Lisa Nutt
Darrien O'Brien
Karl Overman
Lydia Page
Kristopher Palermo
Glenn Palmgren
Al Parker
Walter Pawloski
Lynda Perry
David Peters
Anna Pidgeon
Ron Porter
Diane Potter
Doug Powless
Craig Provost
Bill Purcell
Charles Quinlan
Grace Randolph
Mary Ratliff
Bill Reddinger
Jack Reinoehl
Lauraine Reynolds
Jean Richter
Matt Ricketts
Chris Rimmer
Joseph Robb
Mark Robbins
Don Roberson
Peter Robinson
Scott Robinson
Peter Rodewald
Jennifer Rood
Stephen Ross
Norma Rudesill
Ron Runkles
Maragaret Rusk
Bill Sanderson
Steve Santner
William Schieble
Russ Schipper
John Schukman
Chris Schumacher
Donnette Sellers
Janet Shaffer
Robert Shultz
T. Simons
Debbie Simpkins
Dave Sing
Steve Sjogren
Jack Skalicky
Sheila Sleggs
Chris Sloan
Venett Shari Smith
Carl Smith
Jessica Smith
Marty Smith
Michael Smith
Tom Smythe
Peary Stafford
P. Stanko
Barbara Stedman
Rich Stevens
Dollie Stover
Vori & Joe Strasser
Steve Stacker
Patricia Sulouff
Scott Sutcliffe
Paul Suters
Rob Tallman
Andrew Taylor
Maeve Taylor
Roger Tess
Chris Tessaglia-Hymes
Steve Thomas
William Tolin
David Trently
Glendy Vanderah
Katrina Van Tassel
Bob Van Wagner
Shawchi Vorisek
Ronald Wagner
Allen Waldron
Mindy Walker
Joe Walko
Ron Weeks
Carol Weiss
Alan Wells
Jeffrey Wells
LaRue Wells
Melinda Welton
Richard Whiteford
Whitmore
Martin Wilcox
Gene Wilhelm
Ron Wolf
Joan Wolfe
Doug Wood
Pei-Hsing Wu
Helen Wuestenfeld
Peter Wulfhorst
Alice Yeaman
Matt Young
Yovanovich
G. Ziarno

Subject: Re: Recent TN permits

On 11/4/03 4:56 PM, "Doug Siddell" <DSIDDELL@OSMRE.GOV> wrote:

Here is the requested information. I apologize for the delay in getting this to you.

Company	Permit No.	Permitted Acres	Estimated Disturbed Acres
Appolo Fuels, Inc.	3012	24	24
Appolo Fuels, Inc.	3112	2298	660
Bell County Coal Corp.	3106	15	15
Mountainside Coal Company	3114	277	216
Mountainside Coal Company	3127	351	229
Robert Clear Coal Company	3116	2102	1149
Tennessee Mining, Inc.	3066	62	62

\>
\> From: Melinda Welton <weltonmj@earthlink.net>
\> Date: Mon, 03 Nov 2003 09:38:41 -0600
\> To: Doug Siddell <dsiddell@osmre.gov>
\> Subject: Recent TN permits
\>
\> Doug
\> Just a reminder. When we talked a couple of weeks ago you indicated that you
\> would be able to send me a list of the surface mining permits in the
\> Cumberland Mountains issued since
\> December 2002 with the permitted acreages and the estimated actual surface
\> disturbances.
\>
\> Thank you in advance for your time to do this.
\>
\> Cheers
\> Melinda

SETTING NUMERICAL POPULATION OBJECTIVES FOR PRIORITY LANDBIRD SPECIES

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22 pages, 4 tables, 4 figures

Abstract. -- Following the example of the North American Waterfowl Management Plan, deriving numerical population estimates and conservation targets for priority landbird species is considered a desirable, if not necessary, element of the Partners in Flight planning process. Methodology for deriving such estimates remains in its infancy, however, and the use of numerical population targets remains controversial within the conservation and academic communities. By allowing a set of simple assumptions regarding species' detectability, relative abundance data from Breeding Bird Survey (BBS) routes may be extrapolated to derive first approximations of current, total species populations, both rangewide and within Bird Conservation Regions. Preliminary comparisons with independently derived abundance estimates (e.g., Breeding Bird Atlas) suggest that these population estimates are within acceptable limits of accuracy for many species. If restoring populations to early BBS levels (late 1960s) is desirable, trend data may be used to calculate the proportion of a species' population lost during this 35-year period, and an appropriate population target may be set. For example, in the Lower Great lakes/St. Lawrence Plain, BBS data indicate a current (1990-1999) population of about 14,000 Red-headed Woodpeckers (*Melanerpes erythrocephalus*) and a loss of >50 percent since 1966. A reasonable conservation objective, therefore, may be to double the Red-headed Woodpecker population in this region over some future time period. We encourage the use of numerical population estimates and conservation targets in implementing conservation objectives for priority landbird species, and we encourage further research that leads to refinement of our methodology and our estimates.

Key Words: Breeding Bird Survey, landbirds, population estimates, population objectives.

INTRODUCTION

Conservation actions are most effective and efficient when they are directed towards meeting explicit objectives or targets. In North America, conservation of birds and their habitats has benefited from numerical population targets developed by regional or species experts. For waterfowl and wetland habitats in particular, species-specific population targets were developed and published as part of the North American Waterfowl Management Plan (NAWMP 1986 & Updates). Population targets were based on estimates from survey data from the 1970s, and these served as a baseline for restoring populations of declining species. These numerical targets, when scaled to waterfowl flyways and expressed in terms of habitat-acres or other limiting factors, have proven to be a very compelling tool for generating billions of dollars for wetland protection and restoration (2003 NAWMP Update, 1st draft). More recently, the U.S. Shorebird Conservation Plan has set numerical population targets for priority shorebird species, based on current survey data and also using early 1970s as a baseline (Brown and others 2001). Other examples of numerical population targets exist in the numerous recovery plans for endangered species in the United States and Canada.

Conservation planning for the roughly 500 species of non-endangered landbirds in North America has been proceeding at the regional and national levels through the international initiative, Partners in Flight (Pashley and others 2000). Although much discussion has taken place regarding the desirability and possible nature of population objectives for landbird species, we are just beginning to develop methods for deriving quantitative population targets for widespread and still-numerous species. Such numerical targets require the estimation of species' population size at several geographic scales, knowledge of recent historic population trends, and agreement on timeframes and baselines for setting desirable targets. In this paper we outline a pragmatic and repeatable approach to estimating landbird population sizes using indices from the North American Breeding Bird Survey (BBS, Robbins and others 1989), the most comprehensive and continuous survey of landbird populations in most of the United States and southern Canada. We also discuss the many assumptions and issues that bear on the use of this approach. In addition, we propose a simple protocol for assigning numerical conservation targets for specific regions, based on current population estimates for high-priority species and knowledge of recent population trends. We present preliminary results of population estimation and objective setting for two Bird Conservation Regions (BCRs) in which active bird-conservation initiatives are underway, the Atlantic Northern Forest (BCR 14) and Lower Great Lakes-St. Lawrence Plain (BCR 13). Finally, within these two regions, we compare our BBS-derived population estimates with independent estimates derived from alternative datasets. Additional details and results of our population estimation methods will be published elsewhere (Rich and others in prep., Blancher and Rosenberg in prep.). Our goal here is to introduce a standardized methodology for incorporating numerical population objectives into landbird conservation plans and to stimulate further refinements of the population estimation approach.

METHODS AND ASSUMPTIONS

Our primary method for estimating population size of widespread landbird species involves extrapolation, using indices from the North American Breeding Bird Survey. Specifically, indices of relative abundance (birds per BBS route) were derived from every route surveyed

during the 1990s. Relative abundance indices for each bird species were then averaged across all routes within each Bird Conservation Region. By making a series of assumptions regarding area sampled, habitats sampled, and detectability of individual bird species, we can extrapolate BBS relative abundance to estimate total population size within geographic areas or for the entire continent.

Estimating Population Size From BBS Relative Abundance

A BBS route consists of as a series of 50 point counts, distributed along a 39.4 km (24.5 mile) roadside transect. The starting point and direction of each route are assigned randomly within 1-degree blocks of latitude and longitude in the United States and Canada (Robbins and others 1989). Each route traverses a variety of habitat types; taken together, the routes in a region potentially provide a random sample of the broad landscape within that region as a whole. At each of the 50 BBS stops on a route, observers are instructed to count all birds seen or heard within a 3-minute period, out to a radial distance of 400 m (1/4 mile). The maximum area sampled by each route, without making any corrections for species' detectability (see below), is roughly 25.1 km^2 (Fig. 1).

A formula for estimating regional population density from BBS counts has been presented by Bart (in press). This formula explicitly takes into account the proportion of individual birds that sing (or otherwise are detectable) during the 3-minute BBS stop, the probability that a singing bird will be detected by an observer, and the potential bias due to differences in roadside and region-wide distribution of habitats. An advantage of this formal approach is the ability to calculate error associated with population estimates, and values of 1.0 can be used for probability terms that cannot yet be estimated with empirical data. Bart (in press) provides examples of this approach for a suite of species in shrub-steppe habitats in western United States.

Assumptions: Habitats

For the purpose of our initial analyses, we assume that (1) BBS routes are randomly distributed across larger landscapes (e.g., BCRs), and (2) BBS routes sample habitats in proportion to their occurrence within the larger landscapes. Because BBS routes are assigned at randomly located starting points, and because BBS coverage is widespread across most of the United States and southern Canada, our first assumption is probably reasonable for most of the BBS coverage area. An exception occurs in boreal and arctic BCRs at the northern limit of BBS coverage, where roadless areas predominate and roads typically sample a geographically-biased portion of the landscape.

The second assumption, namely that habitats along roadsides are an adequate sample of habitats throughout the region, is frequently discussed, and is considered by some to be a serious flaw of the BBS. Although the capability now exists to test this assumption using GIS, this analysis has not yet been carried out for the entire survey area, or for many local regions. Those few studies that have examined potential roadside bias have presented mixed results. For example, Bart and others (1995) found that the proportion of forest along BBS routes in Ohio (in a strip out to 280 m from roads) was not significantly different from the proportion in the overall landscape. In an inner strip within 140 m, however, the proportion of forest was significantly less (35 percent)

than in the overall landscape, suggesting that for forest-breeding species detected primarily close to roads (see below), BBS would underestimate abundance. Keller and Scallan (1999) found similar results in Ohio and Maryland, with forest habitats under-sampled by 21-48 percent and agricultural and urban habitats over-represented along roads. Interestingly, forest-field edge habitats also were under-sampled along BBS routes, whereas early successional and wetland habitats did not differ between on-road and off-road landscapes. Most recently, Bart (in press) found that proportions of major forest, shrub-steppe, and grassland habitats along BBS routes did not differ from the surrounding landscape within U.S. Forest Service Region-4, a large area of the western United States. While we urge a continent-wide GIS analysis of roadside bias in the BBS, which could yield BCR-specific correction factors to plug into Bart's equation, for now we assume no roadside bias in our calculations. Further ramifications of this assumption will be discussed below.

Assumptions: Species Detectability

Our initial approach assumes that all breeding pairs of birds very close to an observer at BBS stops are detected, and that detectability is otherwise a function of distance from the observer. We assume that all species have a fixed, average maximum detection distance on BBS routes across their range, and that these distances can be translated into effective sample areas for each species. Because few published data exist on exact detection distances for a wide range of species, we chose to assign species to one of four detection classes as follows (Table 1). A majority of birds on BBS routes in many regions are detected by songs or calls in forested or other densely vegetated habitats. A simple method of extrapolating avian density from counts of singing males using detection threshold distances was proposed by Emlen and DeJong (1981), who also provided average maximum detection distances for 11 species of common forest birds. These distances ranged from 72 m (Blue-gray Gnatcatcher *Polioptila caerulea*) to 186 m (Wood Thrush *Hylocichla mustelina*) and averaged 128 m for the 11 species. Emlen and DeJong (1981) further proposed that numbers of singing males be doubled to obtain a total population. Wolf and others (1995) also found that most forest birds in northern Wisconsin could be heard to maximum distances of between 125 and 250 m. There was much individual variation, however, and some individuals could be heard at much greater distances. Wolf and others (1995) also recorded the minimum distance at which individuals of a species could no longer be heard; this distance also averaged 128 m for the 12 species presented. Based on these empirical data, we chose to initially assign most forest birds and other weakly vocalizing species a detectability threshold of 125 m (close to the average in Emlen and DeJong's study). For these species, we assume that all breeding pairs are detected out to that distance, and the effective area sampled on a complete BBS route is therefore 2.5 km^2.

A second group of species is detected visually or by loud calls over long distances; these include soaring raptors, crows and ravens, Upland Sandpipers (*Bartramia longicauda*), and a few other species with very loud vocalizations (e.g., Northern Bobwhite *Colinus virginianus*, Pileated Woodpecker *Dryocopus pileatus*). For these species, we assume that all breeding pairs are detectable out to the full range of sampling at each BBS stop (i.e., 400 m). The effective sampling area is therefore the same as for the total BBS route, i.e., 25.1 km^2. A third group of species is considered to be intermediate and was assigned a detection distance of 200 m (effective sampling area = 6.3 km^2). These include species such as Bobolink (*Dolichonyx*

oryzivorus) and kingbirds that are detected by a combination of song and visual observations in open habitats.

After initially assigning most forest birds to the 125-m detection threshold category, we made two additional adjustments. First, for species with especially weak vocalizations, such as those with the closest detection thresholds in the above studies (e.g., Blue-gray Gnatcatcher), we created a fourth category with a detection distance of 80 m and an effective sample area for a BBS route of 1.0 km^2. We assigned a few other species that are particularly difficult to detect, such as grouse, into this category as well. Our second adjustment was to move several groups of forest birds with loud or far-carrying vocalizations into the 200-m threshold category. These included Ovenbird (*Seiurus aurocapillus*), most thrushes, pewees, tanagers, and some vireos. Our final estimate of detection-threshold categories was based on a combination of published data, our own personal experience on BBS routes, and consultation with other experienced observers. In future it should be possible to use species-specific detection distances for a majority of species, rather than the categories used here.

In addition to correcting for detectability due to distance from the observer, we know that detectability also varies with time of day throughout a typical BBS route. Although surveys begin before sunrise, during the peak of vocal activity for many species, a full route takes several hours to complete and numbers of birds detected on later stops may be a small fraction of those detected on early stops. To correct for this variation, we examined the distribution of detections among the 50 BBS stops, for 369 species with at least 10 routes of stop by stop data across the entire continental BBS survey. Based on these distribution curves (Fig. 2), we determined the peak detection probability for each species and then the ratio of peak detections to average detections across the 50 stops. This ratio was used to adjust average numbers of birds per route to peak numbers, as if peak detection lasted throughout the morning. Species-specific correction factors ranged from 1.04 (House Finch *Carpodacus mexicanus*) to 22.3 (Whip-poor will *Caprimulgus vociferus*) with a median of 1.34 across all landbird species examined (median of 1.32 for diurnal landbirds). Four different types of time-of-day distributions are illustrated in Figure 2. Using these corrections, we can estimate populations even for crepuscular or primarily nocturnal species (e.g., Great Horned Owl *Bubo virginianus*, Common Nighthawk *Chordeiles minor*), as long as they are detected on several BBS routes on at least the first BBS stop. For the few species without adequate BBS data to calculate a time-of-day correction, we assigned a value based on another similar species with adequate data, or used the median value. Our time-of-day corrections will tend to be conservative for any species whose peak detection is outside of the BBS sample period, diurnally or seasonally.

Finally, we assume that individuals detected represent one member of a pair, and we therefore double all estimates to derive total number of breeding individuals. This "pair correction" is most obvious for the many species that are primarily detected as territorial singing males. Even for species in which males and females may be equally detectable, however, our experience on BBS routes suggests that only one member of a presumed pair is usually detected at any given time. Possible exceptions include some corvids, in which both members of a pair are highly vocal, and swifts and swallows, in which both males and females typically forage together over open habitats. A pair correction of 2 (double) may also be high for species with a high proportion of

singing but unpaired males. The "correct" pair correction for all species lies somewhere between 1 and 2 and may be determined empirically with further study.

Comparisons With Breeding Bird Atlas Estimates.

Few independent population estimates exist with which to make even crude comparisons with our BBS-derived estimates for common landbirds. One source of such data is the simple order-of-magnitude estimates of breeding populations gathered during Breeding Bird Atlas work in Ontario (Cadman and others 1987) and in the Maritime Provinces (Erskine 1992). During the course of atlassing in these areas, observers were asked to estimate the total breeding population of each species within 100-km^2 squares. Although these estimates are very crude (e.g., 1, 2-10, 11-100, 101-1,000, 1,001-10,000 or 10,001-100,000 pairs in a square), precision is gained from the very large number of squares sampled. Because atlassers are not restricted to roads, to early mornings, nor to a single peak of the breeding season, atlas data differ from BBS in having a reduced bias against off-road habitats, seasonal changes in breeding activity, and nocturnal species rarely detected on diurnal routes. Atlases also differ by covering larger proportions of the landscape, providing a larger sample size of population estimates, coverage for rarer species, and allowing extrapolation based on knowledge of the habitat by the observer.

To estimate a population in an area covered by breeding bird atlas, we follow Erskine (1992) in taking the midpoint of each categorical range (assuming a poisson distribution of abundances within each category) as the estimate for the atlas square. These estimates are totaled for each species across all squares in which estimates were made, then extrapolated to account for unsampled squares. This method is illustrated using data for the Brown Thrasher (*Toxostoma rufum*) in the Ontario portion of Lower Great Lakes-St. Lawrence Bird Conservation Region (BCR 13). Brown Thrashers were found in 549 out of 744 censused atlas squares within this region, and estimates within squares ranged across several abundance categories (Fig. 3). Extrapolating abundance from poisson midpoints of these categories, and extrapolating to the full 840 squares in the region, we derive a population estimate for the region of 42,369 pairs. We compared atlas-derived population estimates for landbirds present in 25 or more atlas squares with population estimates based on the 28 BBS routes run from 1981-1985 within the same region. We then replicated this comparison using BBS and atlas data from the Maritime Provinces (part of BCR 14), which involved 1682 atlas squares and 39 BBS routes conducted from 1986-1990. In the Maritime comparison, we used estimates from Erskine (1992) only for species where they were based on data from atlassers, disregarding estimates from other sources.

Comparisons With Breeding Bird Census

Another source of density estimates for landbirds is the Breeding Bird Census (BBC), in which observers estimate breeding populations in small plots of fixed area and uniform habitat. We used the Canadian Breeding Bird (Mapping) Census Database (Kennedy and others 1999) to obtain landbird densities in BCRs 13 and 14 for comparison with our BBS estimates. Because BBC plots are not randomly distributed across the landscape, we use total landbird density as our basis of comparison, rather than density of individual species. We also calculated BBC landbird density within each broad habitat type, and adjusted regional BBC averages according to the proportion of the regional landscape in each habitat type, based on satellite land cover data.

RESULTS

Population Estimates

First approximations of breeding populations were derived for 167 species that were sampled by the BBS in the Lower Great Lakes-St. Lawrence Plain (BCR 13) and for 154 species in the Atlantic Northern Forest (BCR 14). These estimates ranged from roughly 100 breeding individuals for rare breeders such as Dickcissel (*Spiza americana*) and Le Conte's Sparrow (*Ammodramus leconteii*) in BCR 13, and for Peregrine Falcon (*Falco peregrinus*) in both regions, to 10 million American Robins (*Turdus migratorius*) in BCR 13 and 11 million Red-eyed Vireos (*Vireo olivaceus*) and 13 million robins in BCR 14. Breeding population size averaged 488,000 individuals across all landbird species in BCR 13 (398 birds per km^2), whereas populations averaged 792,000 individuals in BCR 14 (340 birds per km^2).

Of particular interest are population estimates for species considered of high conservation concern in these two regions. For BCR 13, we calculated populations for 20 species identified as high priorities by the landbird breakout group of the ongoing BCR 13 bird conservation initiative (see Hayes and others this volume). Our estimates of regional populations for these species ranged from roughly 400 Short-eared Owls (*Asio flammeus*) to 1.9 million Bobolinks (Table 2). We also present average relative abundances on BBS routes in the region, as well as detection distance, effective sampling area, and time-of-day adjustment factors for each of these species. In BCR 14, our population estimates for 20 species with high PIF assessment scores (Panjabi and others 2001) ranged from roughly 10,200 Whip-poor-wills to 2.1 million Veerys (*Catharus fuscescens*; Table 3).

Comparison With Breeding Bird Atlas

We obtained independent estimates of breeding populations for 120 landbird species that had abundance data in at least 25 atlas squares and on at least 1 of 28 BBS routes in the Ontario portion of BCR 13. Correlation between these two sets of estimates was remarkably high (r = 0.95; Fig. 4a). Two-thirds (66 percent) of species had estimates that differed by less than a factor of 2, and 99 percent were within an order of magnitude of each other. For example, in the Ontario/BCR 13 comparison, the atlas method estimated roughly 1.3 million pairs of American Robin versus 1.8 million pairs for the BBS method. Other close comparisons, representing a wide range of common and rare species, included European Starling (*Sturnus vulgaris*; 1.9 million vs. 2.2 million pairs), American Goldfinch (*Carduelis tristis*; 381,000 vs. 363,000), Hairy Woodpecker (*Picoides villosus*; 24,000 vs. 23,000), Great Horned Owl (5,700 vs. 6,300), and Henslow's Sparrow (*Ammodramus henslowii*; 147 vs. 160 pairs). Other individual comparisons that were not as close may suggest incorrect detectability thresholds, differences in habitat coverage between the two survey methods, or lack of precision for rare species.

A similar comparison in the Maritime Provinces portion of BCR 14 also resulted in a high correlation (r = 0.91) between atlas- and BBS-derived estimates for 99 species (Fig. 4b). For this comparison, we relied on Erskine's (1992) calculated estimates, which involved removing the highest 3 percent of abundance estimates for each species, and reducing the midpoint of the top

abundance category. We estimate that this trimming procedure reduced atlas population estimates by more than 50 percent, on average, and resulted in conservative (lower) populations relative to our BBS-derived estimates. Still, atlas and BBS estimates were within a factor of 2 for 64 percent of species, and were within an order of magnitude for all species.

Comparison With Breeding Bird Census

Total population density for all landbird species was approximately three times higher when based on Breeding Bird Censuses, compared with BBS-derived density estimates, in both BCRs (Table 4). Even when BBC densities were corrected for habitat availability in each BCR, BBC densities remained high relative to BBS-derived densities.

Deriving Numerical Population Objectives

To derive numerical population objectives, we start with the premise that a reasonable conservation target is to reverse population declines observed over the past 30-40 years, as measured by BBS or equivalent survey. Rather than extrapolate annual rates of decline over 30-40 years, we chose to use broad classes of population decline as the basis for objectives, as in Rich and others (in prep.). For this purpose we used population trend scores (PT) assigned to species in the PIF species assessment process (Carter and others 2000, Panjabi and others 2001). These scores of 1-5 are based on BBS population trends (or equivalent) over the entire timeframe of the survey, usually since 1966. A PT of "5" is assigned to species that have declined significantly by at least 50 percent over a 30-year period. For these species, our conservation objective is to double current populations over some future time period, and the numerical target is calculated as roughly twice the current population estimate. A PT score of "4" is assigned to species with less certain declines or significant declines of between 15 and 50 percent over 30 years. For these species we propose an objective of restoring populations based on a 30 percent decline (approximately the midpoint of the 15-50 percent range), which translates to a numerical target of about 1.4 times current population. PT scores of "3" are assigned to species with highly variable, uncertain, or unknown population trends. For these, we suggest a conservative objective of maintaining slightly higher populations in the future until we can acquire sufficient trend data to measure trend; i.e., 1.1 times current population estimates. Finally, for species with stable (PT = 2) or increasing (PT = 1) populations, our conservation objective is to maintain future populations at or above current levels.

Note that this categorical assignment of numerical objectives reduces the reliance on specific BBS trend estimates, which often have wide 95 percent confidence limits, especially in regions with small samples of BBS routes. Using this approach, we present conservation objectives and numerical population targets for several species identified as priorities in BCR 13 (Table 2) and BCR 14 (Table 3).

DISCUSSION

We believe that our pragmatic approach, with clearly stated assumptions, can produce useful first approximations of total population size for North American landbirds. Our comparisons with independently derived population estimates suggest that extrapolations from BBS abundance

data typically yield estimates well within the correct order of magnitude. It is likely that our population estimates are conservative for most species, because we did not include any correction for birds that are within detection distance but still not detected during a 3-minute BBS count even at peak detection time of day, i.e. because they didn't vocalize, or because observers missed them. Bart (in press) estimated that 30-70 percent of shrub steppe birds do not call during a 3-minute counts, and a further 20-30 percent of birds singing within detection distance are missed by BBS observers. Our comparisons to BBC landbird densities also suggest our BBS-derived estimates are conservative, perhaps by a factor of 3, though it is possible that BBC densities are high if plots were biased to sites with more birds or if densities were overestimated in small BBC plots.

A habitat bias on BBS routes, if present in the region under consideration, would result in under- or over-estimated populations, so is best measured and incoporated into the estimate (Bart, in press). However, even where habitat bias has not been measured, this does not rule out use of BBS-derived estimates to set and track conservation targets, as long as progress towards objectives is measured using the same method. The same studies that documented a bias against forest sampling on roadside routes (Bart and others 1995, Keller and Scallan 1999) did not find an equivalent bias in terms of the change in land cover over time.

While we are encouraged by the comparisons with other measures of population size, we acknowledge that our estimates are only crude first approximations that might be poor for some groups of birds, or in regions where BBS routes are sparse or strongly habitat-biased. We therefore encourage further research to refine the corrections we have applied so far and to test for and correct any habitat bias in BBS surveys in specific regions. Studies of species-specific detection distances, vocalization frequency, detection probabilities of males and females, and proportion of unpaired birds detected would all be extremely useful for refining population estimates. Our efforts thus far have focused on landbird species, which as a group are reasonably well sampled by BBS. These methods may also be appropriate for some species of waterfowl, shorebirds and waterbirds that are typical of landscapes sampled by BBS; testing is needed to confirm this. Finally, our method does not address vast boreal/taiga and arctic regions of North America that are not sampled by BBS. Other methods will be needed to estimate populations of these far-northern breeding species (Rich and others in prep.). We invite additional comparisons and discussion, and we encourage the testing of these methods on other species and in other regions.

Even if we accept the first approximation of landbird population estimates as reasonable, using these to set numerical conservation targets remains controversial. Fear exists among academic ornithologists and conservation practitioners that using inaccurate population estimates to set conservation targets may lead to misdirected conservation actions and loss of scientific credibility. Alternative forms of population objectives have been proposed and discussed, including using minimum block sizes of habitats for maintaining "source" or "viable" populations, using BBS relative abundance as a surrogate for population size (e.g., achieve a regional density of x birds per BBS route), and using raw trend estimates as objectives (e.g., stabilizing a 2 percent per year BBS decline). Our assumption in using explicit population estimates is that there is compelling value in knowing the magnitude of population change desired, and having easily understood objectives. Population estimates also allow comparisons to

independently-estimated sources of mortality and a grasp of the magnitude of habitat required to sustain bird populations across the landscape.

Other considerations in setting conservation targets relate to timeframes, historic baselines, and political and social acceptability of objectives. We selected "early BBS" as a reasonable historic reference because it represents the extent of our knowledge of population trends for most species, and because it is a similar timeframe to that proposed for the restoration of waterfowl and shorebird populations. Just as important, it also allows a comparable measurement of success into the future, using the same BBS methodology. Numerous factors could make it desirable to alter this timeframe, however. For example, some populations and habitats were severely altered long before the beginning of the BBS, and it may be desirable to attempt restoration of these to some earlier baseline. Alternatively, some populations or habitats may have been artificially abundant in the 1960s (relative to pre-settlement conditions), such as some early successional habitats in eastern regions, or populations responding to spruce-budworm outbreaks, and proposing the return to these levels may be inappropriate. Full discussion of these and other factors is critical for setting effective and achievable conservation targets, but such a discussion is beyond the scope of our paper. Our proposed method for setting numerical targets can be adapted to a variety of baselines or timeframes.

In conclusion, we believe that numerical population estimates and conservation targets for landbird species are useful and achievable. We propose a simple methodology for extrapolating from widely available BBS abundance data, while stating a series of assumptions and acknowledging the limitations of this approach. We encourage further research that aims to refine population estimates and better enables us to understand and use data from the BBS. We further encourage the use of additional survey data, point counts, checklist counts, and other measures of abundance to fill in gaps for species and regions poorly covered by BBS. Finally we encourage the use of population-based conservation targets in continental and regional plans as a compelling means of justifying and communicating levels of desired population and habitat change in specific regions.

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Table 1. CATEGORIES OF DETECTION DISTANCES AND EQUIVALENT BBS SAMPLING AREA FOR LANDBIRDS.

Maximum detection distance	Effective BBS sample area / route	Example species
80 m	1 km^2	Brown Creeper, Blue-gray Gnatcatcher, Golden-crowned Kinglet, Ruffed Grouse
125 m	2.5 km^2	Most forest-breeding warblers, Red-eyed Vireo, Downy Woodpecker, accipiters
200 m	6.3 km^2	Thrushes, waterthrushes, wood-pewees, meadowlarks, Bobolink, Song Sparrow
400 m	25.1 km^2	Whip-poor-will, Pileated Woopecker, Red-tailed Hawk, crows, vultures

Table 2. POPULATION ESTIMATES AND NUMERICAL OBJECTIVES FOR LANDBIRD SPECIES IDENTIFIED AS PRIORITY BY HAYES AND OTHERS (THIS VOLUME) IN LOWER GREAT LAKES-ST. LAWRENCE PLAIN, BCR 13

Species	BBS avg / rte	Maximum detection distance	BBS sample area (km^2)	Time of day adjust	BCR population (individuals)	PT	BCR population objective	Numerical target (rounded)
Northern Harrier	0.302	400m	25.1	1.29	6,200	3	1.1 X pop	6,900
Black-billed Cuckoo	0.746	200m	6.3	1.39	66,100	4	1.4 X pop	93,000
Short-eared Owl	0.004	200m	6.3	1.60	400	5	2 X pop	800
Whip-poor-will	0.017	400m	25.1	22.3	6,100	5	2 X pop	8,500
Red-headed Woodpecker	0.178	200m	6.3	1.25	14,200	5	2 X pop	28,000
Eastern Wood-Pewee	3.477	200m	6.3	1.12	249,200	4	1.4 X pop	350,000
Acadian Flycatcher	0.271	125m	2.5	1.17	51,100	2	Current pop	51,000
Loggerhead Shrike	0.007	200m	6.3	1.19	500	5	2 X pop	1,000
Sedge Wren	0.025	125m	6.3	1.62	2,600	3	1.1 X pop	2,900
Wood Thrush	6.081	200m	6.3	2.30	892,200	4	1.4 X pop	1,200,000
Brown Thrasher	1.499	200m	6.3	1.12	107,800	5	2 X pop	215,000
Blue-winged Warbler	0.565	200m	6.3	1.21	43,700	2	Current pop	44,000
Golden-winged Warbler	0.123	200m	6.3	1.32	10,300	2	Current pop	10,000
Cerulean Warbler	0.100	125m	2.5	1.35	21,800	2	Current pop	22,000
Hooded Warbler	0.357	200m	2.5	1.20	68,800	2	Current pop	69,000
Field Sparrow	3.572	200m	6.3	1.07	243,800	5	2 X pop	490,000
Henslow's Sparrow	0.025	200m	6.3	1.66	2,700	5	2 X pop	5,600
Grasshopper Sparrow	0.476	200m	6.3	1.47	44,700	5	2 X pop	89,000
Bobolink	24.863	200m	6.3	1.21	1,927,000	4	1.4 X pop	2,700,000

Notes: Area of BCR13 is 201,292 km^2. Pair adjust = 2 for all species. For descriptions of detection distance categories, BBS effective sample areas for each species, pair adjustment, time-of-day adjustments and population trend (PT) scores, see Methods.

Table 3. POPULATION ESTIMATES AND NUMERICAL OBJECTIVES FOR LANDBIRD SPECIES WITH HIGH PIF ASSESSMENT SCORES IN ATLANTIC NORTHERN FOREST, BCR 14

Species	BBS avg / rte	Maximum detection distance	BBS sample area (km^2)	Time of day adjust	BCR population (individuals)	PT	BCR population objective	Numerical target (rounded)
Broad-winged Hawk	0.190	125m	2.5	2.63	143,100	2	Current pop	140,000
Ruffed Grouse	0.218	80m	1	1.37	214,700	5	2 X pop	430,000
Whip-poor-will	0.016	400m	25.1	22.3	10,200	4	1.4 X pop	14,000
Yellow-bellied Sapsucker	3.351	125m	2.5	1.40	1,342,700	4	1.4 X pop	1,880,000
Black-backed Woodpecker	0.043	125m	2.5	1.81	22,300	3	1.1 pop	25,000
Olive-sided Flycatcher	0.551	200m	6.3	1.25	78,700	5	2 X pop	160,000
Veery	10.889	200m	6.3	1.67	2,071,600	4	1.4 X pop	2,900,000
Wood Thrush	4.983	200m	6.3	2.30	1,302,900	5	2 X pop	2,600,000
Chestnut-sided Warbler	7.622	200m	6.3	1.23	1,070,000	4	1.4 X pop	1,500,000
Cape May Warbler	0.371	125m	2.5	1.31	139,900	4	1.4 X pop	196,000
Black-throated Blue Warbler	1.988	125m	2.5	1.12	639,400	2	Current pop	640,000
Blackburnian Warbler	2.324	125m	2.5	1.28	852,700	1	Current pop	850,000
Bay-breasted Warbler	0.727	125m	2.5	1.28	267,100	4	1.4 X pop	370,000
Canada Warbler	1.216	125m	2.5	1.25	436,500	5	2 X pop	870,000
Scarlet Tanager	1.496	200m	6.3	1.14	193,500	2	Current pop	190,000
Nelson's Sharp-tailed Sparrow	0.077	125m	2.5	1.92	42,400	3	1.1 X pop	47,000
Rose-breasted Grosbeak	2.731	200m	6.3	1.09	340,400	4	1.4 X pop	480,000
Bobolink	7.271	200m	6.3	1.21	1,004,100	4	1.4 X pop	1,400,000
Rusty Blackbird	0.179	200m	6.3	1.44	29,300	5	2 X pop	59,000

Notes: Area of BCR14 is 358,697 km^2. Pair adjust = 2 for all species. For descriptions of detection distance categories, BBS effective sample areas for each species, pair adjustment, time-of-day adjustments and population trend (PT) scores, see Methods.

Table 4. COMPARISON OF TOTAL LANDBIRD DENSITY FROM BREEDING BIRD CENSUS (BBC) PLOTS VS ESTIMATES BASED ON BREEDING BIRD SURVEY (BBS), FOR BCRS 13 AND 14

BCR	BBC plots (N)	BBC landbird density (prs/km2)	BBC density weighted by habitat in BCR (prs/km2)	BBS landbird density (prs/km2)	Ratio BBC / BBS
BCR 13	204	592	506	198	2.6
BCR 14	93	632	621	210	3.0

Note: Estimates are for Canadian portions of the BCRs.

Figure Legends:

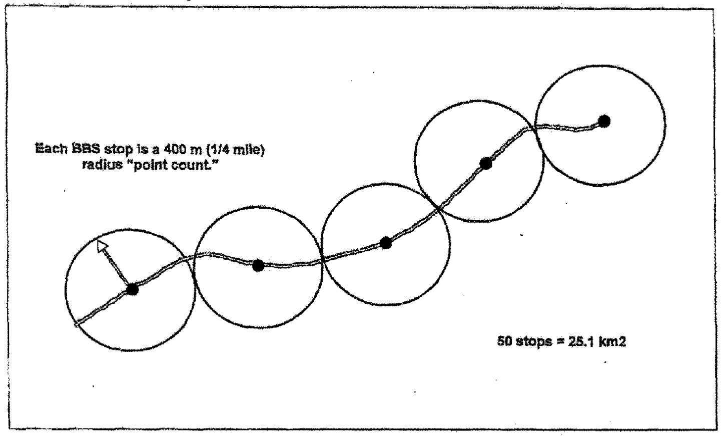
Figure 1. Schematic of a BBS route, illustrating how the 50 roadside points, each sampling out to a distance of 400m, can sample a maximum of 25.1 km^2.

Figure 2. Distribution of detections across 50 BBS stops for four species with contrasting temporal patterns. Lines are 6^{th} order polynomial regressions fit to the data. Numbers are time of day adjustments (max detection / avg detection) used in population estimates.

Figure 3. Brown Thrasher pair estimates in 10 x 10 km squares in the Ontario portion of BCR 13, from the Ontario Breeding Bird Atlas, 1981-1985.

Figure 4. Comparison of BBS- and Atlas-derived population estimates: A. Ontario portion of BCR 13, 1981-1985; B. Maritime provinces (BCR 14), 1986-1990. Line shows equal BBS and Atlas values. Landbirds with atlas estimates from 25+ atlas squares and found on 1 or more BBS route are included.

Figure 1


Each BBS stop is a 400 m (1/4 mile) radius "point count."
50 stops = 25.1 km2

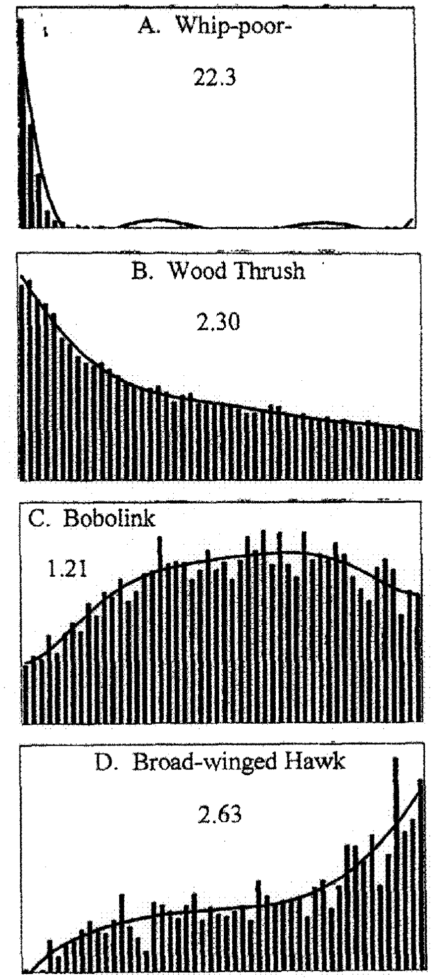

A. Whip-poor-
22.3
B. Wood Thrush
2.30
C. Bobolink
1.21
D. Broad-winged Hawk
2.63

Figure 3

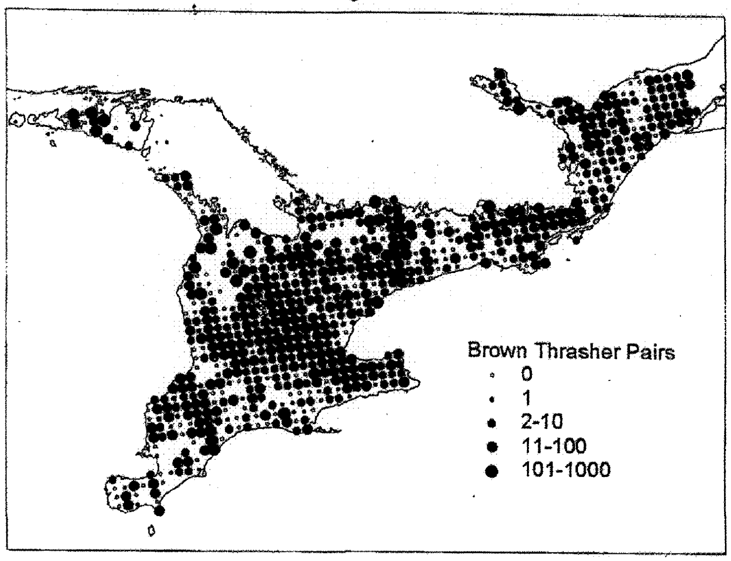
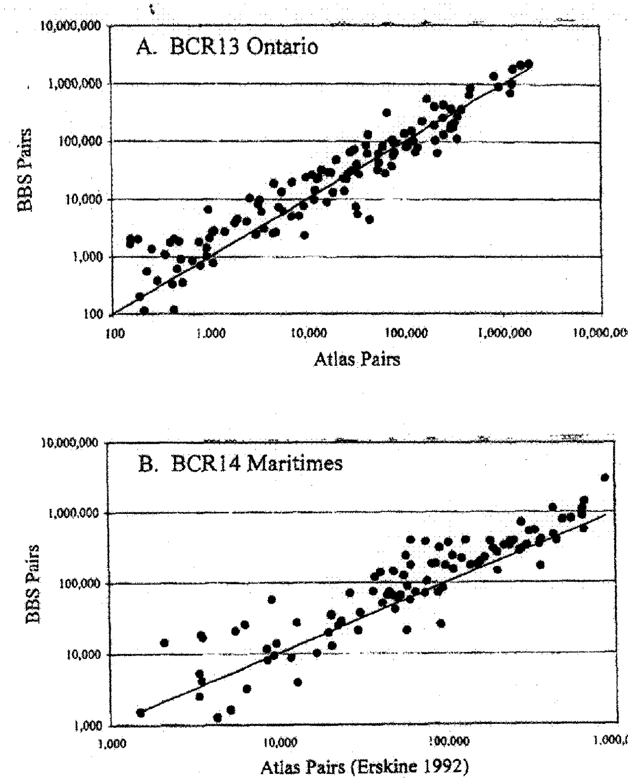


Figure 4



Subject: Re: Recent TN permits

On 11/4/03 4:56 PM, "Doug Siddell" <DSIDDELL@OSMRE.GOV> wrote:

Here is the requested information. I apologize for the delay in getting this to you.

Company	Permit No.	Permitted Acres	Estimated Disturbed Acres
Appolo Fuels, Inc.	3012	24	24
Appolo Fuels, Inc.	3112	2298	660
Bell County Coal Corp.	3106	15	15
Mountainside Coal Company	3114	277	216
Mountainside Coal Company	3127	351	229
Robert Clear Coal Company	3116	2102	1149
Tennessee Mining, Inc.	3066	62	62

\>
\> From: Melinda Welton <weltonmj@earthlink.net>
\> Date: Mon, 03 Nov 2003 09:38:41 -0600
\> To: Doug Siddell <dsiddell@osmre.gov>
\> Subject: Recent TN permits
\>
\> Doug
\> Just a reminder. When we talked a couple of weeks ago you indicated that you
\> would be able to send me a list of the surface mining permits in the
\> Cumberland Mountains issued since
\> December 2002 with the permitted acreages and the estimated actual surface
\> disturbances.
\>
\> Thank you in advance for your time to do this.
\>
\> Cheers
\> Melinda

BRADEN MOUNTAIN SURFACE MINE

CAMPBELL AND SCOTT COUNTIES, TENNESSEE

1 PURPOSE AND NEED FOR ACTION

In November 1999, TVA approved a mining plan submitted by Gatliff Coal Company for mining TVA-owned coal in the Koppers Coal Reserve in Campbell and Scott Counties, Tennessee. Most of the land surface over the Koppers Coal Reserve, including the area of the approved mine, is within the Royal Blue Wildlife Management Area and owned by Tennessee Wildlife Resources Agency (TWRA). The mine, known as Braden Mountain Area No. 16, had a permitted area of 664.5 acres and would have used a variety of surface mining techniques. Gatliff had previously been issued the necessary approvals for the mining plan by the Office of Surface Mining Reclamation and Enforcement (OSM) and the Tennessee Department of Environment and Conservation. As part of its approval process, OSM completed an Environmental Assessment and Finding of No Significant Impact (OSM 1999). TVA cooperated with OSM in the preparation of this EA, conducted its own independent review of this EA, and adopted this EA and issued its own FONSI as part of its November 1999 approval (TVA 1999).

Shortly after the November 1999 approval and before the initiation of mining activities, Gatliff terminated its lease agreement with TVA because changed coal market conditions had made the proposed mining operation uneconomical. OSM placed Gatliff's mining permit in inactive status.

Recent changes in coal market conditions have made the formerly proposed mining operation more economically attractive. TVA therefore proposes to enter into a new lease agreement that would result in mining coal in the Braden Mountain area. This EA evaluates the environmental impacts of the lease agreement and resulting coal mining operation, and supplements the EA prepared by OSM and adopted by TVA in 1999. It also addresses issues that have arisen since 1999.

2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1 The Proposed Action

TVA proposes to enter into a lease agreement with a coal mining company that would result in the mining of TVA-owned coal in the Braden Mountain area. The mining operations would be carried out as described in the mine plan previously submitted by Gatliff Coal Company (Gatliff Coal Company 1999). The mine would produce about 300,000 tons of coal per year over a 7.4 year period, for a total production of 2,232,817 tons. Major features of the mine are illustrated in Figure 1.

1

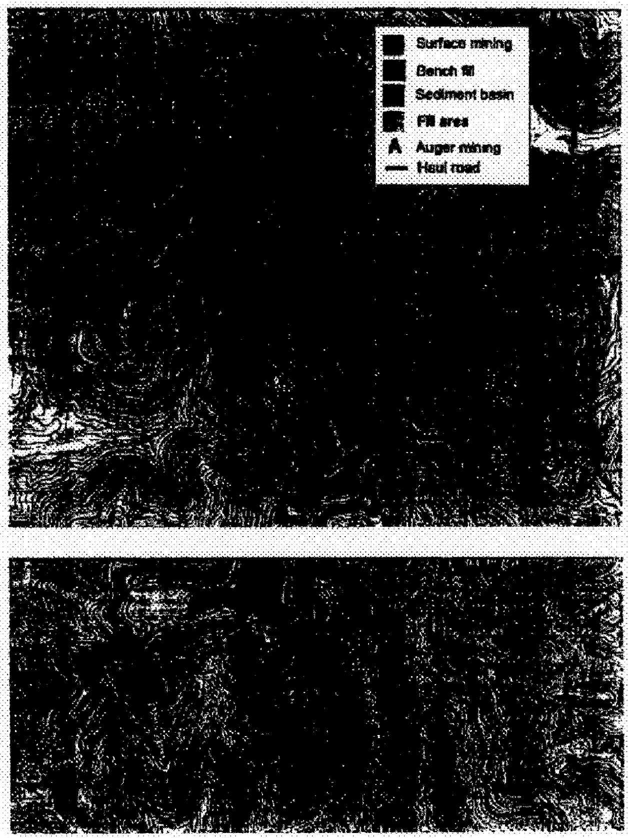


Figure 1. Major features of the proposed Braden Mountain surface mine.

2

As decribed in the Gatliff Coal Company mining plan, coal would be mined from five seams – Upper Pine Bald, Lower Pine Bald, Pewee, Walnut Mountain, and Red Ash. Mining techniques would include contour mining, cross ridge mining, second cut mining, and auger mining. The mine permit area, as defined by OSM regulations, is 664.5 acres. The area of surface disturbance, including roads, settling ponds, and fills, totals 526.5 acres. Haul roads would occupy about 86 acres, and light duty access roads to sediment basins would occupy 9 acres. Contour, cross ridge, and second cut mining would disturb an area of 320.6 acres. Auger mining would occur on 138 acres, on which there would be little surface disturbance.

Fill areas for excess overburden would total 90 acres. Four fill areas totalling 22.1 acres would be on old orphan mine benches, mostly on the 2300-foot contour. Six fill areas totalling 33.2 acres would be valley fills. The largest valley fill would be 9.8 acres, and portions of two of the valley fills would be on abandoned mine benches. The remaining four fill areas, totalling 34.7 acres, would be located within newly mined areas. Twenty-five sediment basins, ranging from 0.4 to 1.8 acres in size, would be constructed. Seven of these sediment basins would be within newly mined areas. The 18 other sediment ponds would have a total area of 18 acres; 14 of these 18 ponds would be on abandoned mine benches.

Almost all of the proposed roads outside of the area to be mined follow existing roads. Most of these roads would be regraded and many segments would be widened. About 0.6 miles of new road would be constructed between Elk Gap on Highway 297 and Braden Gap.

Hydrologic impacts would be minimized by measures described in a Hydrologic Reclamation Plan submitted as part of the Gatliff mine permit application. Haulroads would be constructed with durable material and culverts would be installed. Disturbed areas along roads would be quickly revegetated. All runoff from the actual mine site would be diverted by berms, drainage ditches, and natural drainways to sediment basins. Sediment ponds would be designed for a 10 year/24 hour precipitation event and have discharge structures to maintain a steady flow after precipitation events. Alternative sediment control devices, such as hay bales and filter fabric fence, would be utilized during early construction activities before basins are completed. Drainage structures would be lined with grass or rock as necessary, and incorporate splash ponds to control erosion. Storage of coal on the mine site would be minimized, and runoff from temporary coal stockpiles would drain to sediment basins. Fill areas would be constructed with diversion channels around their perimeters and rock drains beneath the fills to route both sufrace runoff and groundwater flow to sediment basins. Sediment basin discharges would be monitored and treated as necessary to meet effluent limitations.

Mine reclamation would be contemporaneous with mining. Backfilling of spoil would be used to eliminate highwalls and return the area to approximate original contour. Topsoil would be segregated during mining and redistributed over the area during reclamation. The postmining land use would be wildlife habitat. Revegetation measures to be implemented at the request of the TWRA and the U.S. Fish and Wildlife Service include planting warm season grasses on 20 acres of flat areas on top of the valley fills and planting 12.5 acres in hardwood species that would mature to provide potential bat roosting trees. Acceptable species include post oak, chestnut oak, persimmon, northern red oak, white oak and sawtooth oak; sawtooth oak would not compose more than 25 percent of the plantings. An additional 14 acres would be planted in a mix of trees and shrubs. Both the hardwood

3

plantings and the tree/shrub plantings would be in discrete blocks distributed across the mine area. The remainder of the area would be planted with a mixture of grasses and legumes. Sediment basins would be retained by TWRA for wildlife habitat enhancement; some basins may be modified to enhance their wetland characteristics.

2.2 Alternatives to the Proposed Action

Under the No Action alternative, TVA would not enter into a lease agreement for the mining of TVA-owned coal in the Braden Mountain area. The coal would not be mined as described above and TVA would not receive royalty payments.

3 AFFECTED ENVIRONMENT

3.1 Vegetation

The project area lies within the Cumberland Mountain subprovince of the Cumberland Plateau Physiographic Province as described by Fenneman (1938). It is also within the Mixed Mesophytic Forest Region as defined by Braun (1950). Historically, forests of this region were dominated by a mixture of deciduous trees including several oaks (northern red, white, black, scarlet, and chestnut oaks), red maple, sugar maple, yellow-poplar, basswood, cucumbertree, black cherry, yellow buckeye, sweet birch, blackgum, white ash, and, formerly, American chestnut. Pines occur on some south- and west-facing ridges and hemlock often occurs in stream bottoms.

The project area includes two peaks on Braden Mountain, with elevations of about 2640 and 2700 feet. The surrounding topography is steep and rugged. Most of the area has been previously disturbed by logging and/or coal mining. Deep mining has occurred in the area, although relatively little evidence of this disturbance remains. Abandoned contour surface mines surround much of Braden Mountain at about 2300 feet elevation. These mines are generally less than 100 yards wide and mostly reforested. Larger abandoned surface mines are present between about 1900 and 2150 feet elevation on the south side of Braden Mountain and between Braden Mountain and Highway 63. These mines are partially revegetated.

The dominant vegetation type is upland hardwood forest. Forests on Braden Mountain range from sapling to sawtimber-size. A large portion of the southern Braden Mountain site was logged in about 1999 to prepare for mining by Gatliff Coal Company. This area is vegetated by a mixture of hardwood saplings, pole-sized trees and scattered snags, and has a dense shrub layer dominated by blackberry and pokeweed. Forests on the ridgetops and south and west slopes are dominated by scarlet and chestnut oaks, mockernut hickory, red maple, and sourwood. Common understory species found in these forests include mountain laurel, flame azalea, pinxter flower, greenbrier, and Christmas fern. Forests on north and east slopes support more mesic species including yellow-poplar, yellow buckeye, white oak, northern red oak, sweet birch, cucumbertree, and basswood. These forests have a rich herbaceous understory; common species include black cohosh, wild ginger, and painted trillium. Dominant trees on the abandoned mines are black locust, yellow-poplar, and red maple; Virginia pine, shortleaf pine, and white pine are also present. Many of the pines have recently died from southern pine beetle infestation.

The distribution, estimated age class, and composition of the forest communities in the project area are representative of the greater Cumberland Mountain region (Smalley 1984; Hinkle et al. 1993). Review of all natural communities thus far defined in the International Classification of Ecological Communities indicates that none of the plant communities are currently considered to be imperiled (have been assigned a global conservation rank of G1 or G2; NatureServe 2002). In summary, no plant communities of state, regional, or global significance occur within the project area.

3.2 Wildlife

The primary wildlife habitat in the Braden Mountain area consists of upland hardwood forest. Previous mining and timber harvesting activities have resulted in an overall mixture of age classes of trees in most forested portions of the study area. Age classes range in age from mixed sapling and pole-sized stands to mature sawtimber-sized, second-growth forest. Mast producing trees such as hickories and a variety of oaks are common in the project area. Other prominent tree species in the area include yellow-poplar and red maple.

A portion of the area (described in Section 3.1) was logged in about 1999 in preparation for the mining proposed by Gatliff Coal Company. Roads, partially vegetated abandoned surface mines, and exposed rock highwalls provide additional early successional habitats. Prominent species of plants in these early successional habitats include princess tree, redbud, black locust, elderberry, and blackberry.

As part of the Royal Blue Wildlife Management Area (RBWMA), the study area is managed for wildlife such as white-tailed deer, wild turkey, gray squirrel, raccoon, quail and ruffed grouse. The Tennessee Wildlife Resources Agency (TWRA) has recently reintroduced elk and bear into RBWMA. Elk sign was observed in the Braden Mountain area during field investigations. Black bear are occasionally sighted in the lower elevations of RBWMA.

In addition to the game species listed above, other common mammals in the project area include gray fox, eastern chipmunk, woodland vole, white-footed mouse, house mouse, big brown bat, red bat, and short-tailed shrew. Reptiles and amphibians observed within the area include eastern box turtle, green frog, leopard frog, gray tree frog, five-lined skink, fence lizard, red-spotted newt, American toad, garter snake, and black rat snake. A few small ponds on abandoned mine benches provide habitat for several species of amphibians. Northern copperhead and timber rattlesnake were also observed during field visits.

A few abandoned mine portals occur within the Braden Mountain permit area. These cave-like environments can provide habitat for numerous species of small mammals, such as white-footed mice, and several species of bats. Birds such as eastern phoebe and Carolina wrens also frequently build nests in mine openings.

The permit area supports a diverse bird population, comprised mostly of forest-dwelling species. About half of the approximately 55 species of birds breeding in the mine permit area are neotropical migrants which winter in the Caribbean and Latin America. The most abundant species present in pole- to sawtimber-sized forest are, in descending order of abundance, the red-eyed vireo, ovenbird, cerulean warbler, scarlet tanager, American redstart, black-and-white warbler, and hooded warbler. Indigo buntings, eastern towhees, and northern cardinals are common in forest edges and in the portion of Braden Mountain cutover 3 to 4 years ago. Other birds typical of early successional habitats occurring in the cutover area are the chestnut-sided warbler, yellow-breasted chat, American goldfinch, and field sparrow. Several birds more typical of later successional forest including the red-eyed vireo, black-and-white warbler, hooded warbler and Kentucky warbler also occur in the cutover area, especially around its perimeter.

3.3 Endangered and Threatened Species

3.3.1 Plants

Review of the TVA Natural Heritage and the Tennessee Division of Natural Heritage Program databases revealed that three federally listed and 37 additional state-listed plant species are known from Campbell and Scott Counties, Tennessee (Appendix 1). These species lists formed the basis of field surveys for rare plant species, which were conducted in June and August 2002.

No federal-listed plant species, or suitable habitats for such species, were observed during field surveys of the project area. However, a single individual of goldenseal (*Hydrastis canadensis*), state-listed as of special concern because of commercial exploitation, was found on the northern Braden Mountain area.

During the surveys conducted in June 2002, several areas of potentially suitable habitat for several state-listed species were observed. These areas were re-evaluated during follow-up surveys conducted in August 2002. The majority of available habitat is less than optimal for the rare plant species potentially occurring in the project area. No additional occurrences of rare plant species were observed during these follow-up surveys conducted in August 2002.

3.3.2 Terrestrial Animals

A review of the TVA Regional Natural Heritage Program database indicates that several species of amphibians, reptiles, birds, and mammals that potentially occur in the project area are protected under state and/or federal law. Table 1 lists these species and their individual legal status.

Four protected species of salamanders are reported from the vicinity of RBWMA. Eastern hellbenders are large aquatic salamanders that live in cool, well-oxygenated streams. The species has been reported from nearby Cove Lake and portions of Cove Creek. However, hellbenders are not expected in the project area due to heavy silt loads in associated streams. Black Mountain dusky salamanders are associated with permanent streams. Due to the semi-permanent nature of the small streams on the Braden Mountain area, suitable habitat for this species is limited in the project area.

The two remaining species of salamanders, four-toed, and Wehrle's, potentially exist in the project area. These salamanders are associated with the margins of small vernal ponds or moist bluff faces. Records of both species are reported from nearby areas. Former strip mining operations in the study area created several small depressions that temporarily collect water. Many of these depressions are suitable habitat for four-toed salamanders. The Wehrle's salamander has only been found in one locality in Tennessee; researchers are currently searching for the species in the RBWMA. Highwalls created during former mining activities and sandstone outcrops in the project site represent suitable habitat for this species.

Table 1. Endangered, threatened, or otherwise listed terrestrial animals known from Campbell and Scott Counties, Tennessee.

Common Name	Scientific Name	State Status	Federal Status
	Amphibians		
Eastern Hellbender	*Cryptobranchus a. alleghaniensis*	In Need of Management	—
Black Mountain Dusky Salamander	*Desmognathus welteri*	In Need of Management	—
Four-toed Salamander	*Hemidactylium scutatum*	In Need of Management	—
Wehrle's Salamander	*Plethodon wehrlei*	In Need of Management	—
	Birds		
Sharp-shinned Hawk	*Accipiter striatus*	In Need of Management	—
Cerulean Warbler	*Dendroica cerulea*	In Need of Management	—
Peregrine Falcon	*Falco peregrinus*	Endangered	—
Swainson's Warbler	*Limnothlypis swainsonii*	In Need of Management	Management Concern*
Red-cockaded Woodpecker	*Picoides borealis*	Endangered	Endangered
Bewick's Wren	*Thryomanes bewickii*	Endangered	—
Barn Owl	*Tyto alba*	In Need of Management	—
Golden-winged Warbler	*Vermivora chrysoptera*	In Need of Management	Management Concern
	Mammals		
Eastern Big-eared Bat	*Corynorhinus rafinesquii*	In Need of Management	—
Gray Bat	*Myotis grisescens*	Endangered	Endangered
Eastern Small-footed Bat	*Myotis leibii*	In Need of Management	—
Indiana Bat	*Myotis sodalis*	Endangered	Endangered
Woodland Jumping Mouse	*Napaeozapus insignis*	In Need of Management	—
Allegheny Woodrat	*Neotoma magister*	In Need of Management	—
Hairy-tailed Mole	*Parascalops breweri*	In Need of Management	—
Common Shrew	*Sorex cinereus*	In Need of Management	—
Smoky Shrew	*Sorex fumeus*	In Need of Management	—
Southeastern Shrew	*Sorex longirostris*	In Need of Management	—
Southern Bog Lemming	*Synaptomys cooperi*	In Need of Management	—

*Management Concern is a non-regulatory status indicating concern for the species.

Eight protected species of birds are reported from Campbell and Scott counties. Two, the red-cockaded woodpecker and the Bewick's wren, are considered extirpated from the area.

A colony of red-cockaded woodpeckers occurred in the eastern portion of RBWMA from at least the 1970s into the early 1980s. This species requires large areas of mature to old growth pines. No suitable habitat exists in the vicinity of Braden Mountain, and the woodpecker is now considered by TWRA to be extirpated from the State. There are two races of Bewick's wren in Tennessee. The Appalachian race formerly nested in Campbell County, however its numbers have dropped drastically. The Appalachian Bewick's wren no longer exists in much of east Tennessee. The Bewick's wren is reported from middle and west Tennessee, where it occurs in open woodlands, upland thickets and fencerows in agricultural areas (Nicholson 1997). This species has also recently declined in numbers. Neither subspecies of Bewick's wren is expected to occur in the project area.

Four state-listed species of birds potentially occur in the vicinity of the project area. Swainson's warblers are rare summer residents of RBWMA. The species is occasionally observed along Cove Creek. The Swainson's warbler is associated with extensive thickets of rhododendron or in thick vegetation along waterways. Limited suitable habitat exists in the project area. Peregrine falcons likely migrate through the project area. The species historically nested on cliffs in eastern Tennessee. The species likely nested within 18 miles of Braden Mountain in 1950s (Nicholson 1997). Exposed highwalls at Poteet Gap would provide marginal habitat for this species. Sharp-shinned hawks are uncommon in the area, but could be found in the project area year round. It is most numerous during the fall and spring, when the species migrates through the area. It typically nests in pines within mixed pine-hardwood forests, and forages in open forests and forest edges. Barn owls prefer to nest in semi-forested bluffs, hollow trees, and old buildings. Highwalls in the Poteet Gap area represent suitable nesting habitat for this species.

Two state-listed species of warblers, the golden-winged and the cerulean, nest in the project area. The golden-winged warbler is fairly common in the Royal Blue area and occupies old fields and revegetated surface mines with a ground cover of grasses and forbs, clumps of shrubs, and scattered trees. Potentially suitable habitat for this bird occurs on a reclaimed surface mine a short distance NNW of Poteet Gap; no golden-wings were observed in this area or elsewhere within the Braden Mountain mine permit area. The grass/forb ground cover on the recently logged southern portion of the Braden Mountain site is not extensive enough to provide habitat for the golden-winged warbler.

The cerulean warbler is a common summer resident of mesic hardwood forests in the Cumberland Mountains. It occupies mixed age to mature stands, usually with an open understory and scattered canopy gaps. It reaches some of its highest rangewide densities in the Cumberland Mountains (Nicholson 1997) and is one of the most numerous songbirds on RBWMA (Nicholson unpubl. data). Cerulean warblers have been reported on 8 bird census plots containing suitable forest habitat on or adjacent to RBWMA. Their density on these plots ranged from 5 to 51 pairs/100 acres (12 to 125 pairs/100 ha) and averaged 25.8 pairs/100 acres (64 pairs/100 ha) (censuses published in *Audubon Field Notes* and *American Birds*; Nicholson unpubl. data).

During May and June 2002, cerulean warblers were recorded at 26 of 43 point counts conducted in the Braden Mountain mine permit area. The proportion of counts recording cerulean warblers, 60%, is very similar to the proportion of a larger sample of point counts (220 of 357, 62%) censused in the portion of RBWMA west of I-75 in 1995-1997. Assuming that the proportion of point counts recording cerulean warblers is indicative of the proportion of the area occupied by cerulean warblers and the average density within occupied areas is

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25.8 pairs/100 acres, about 104 pairs of cerulean warblers likely occur within the 665 acre Braden Mountain mine permit area.

Several protected species of bats are known from Campbell and Scott Counties. Eastern big-eared bats form colonies in hollow trees, crevices in sandstone bluffs, cisterns, and abandoned buildings. Eastern small-footed bats roost in abandoned mines, under rocks in talus slopes, in crevices in bluffs and expansion joints in bridges. Both species forage in forested habitats and usually hibernate in caves. Suitable roosting and foraging habitats for big-eared and small-footed bats are present in the Braden Mountain area.

The endangered gray bat is known from Campbell and Scott Counties. Gray bats occupy caves throughout the year. Summer roosts are usually formed in caves near water. Gray bats typically forage over larger streams, rivers, and reservoirs. During winter months, they migrate from their summer colonies to hibernate in cooler caves. Gray bats have been found hibernating in New Mammoth Cave, approximately 7 miles from Braden Mountain.

The endangered Indiana bat forms small roosts under the exfoliating bark of dead trees during summer months. Several species of trees that have flaky bark, such as white oak and shagbark hickory, are also used as roost sites. Roosts trees may be found in riparian or upland forests near streams. There are only a few small maternity colonies known from Tennessee. No colonies are known from the RBWMA, but forested areas in the project area are suitable for Indiana bats. Indiana bats hibernate in caves during winter months. Approximately 85% of the total Indiana bat population roosts in 7 caves north of Tennessee. The remainder of the population forms small colonies in caves throughout the species range, including several sites in Tennessee. A small colony hibernates in New Mammoth Cave.

Abandoned coal mine portals can provide potential hibernating sites for both the gray bat and the Indiana bat. One such site, on a northeast slope of the southern portion of the Braden Mountain site, was surveyed in January, 1999. The site was found to be too warm to be used as a gray bat or Indiana bat hibernaculum. Two other portals occur on abandoned mine benches at about 2300 foot elevation; one of these is on the northwest slope of the southern portion of the Braden Mountain site and the other is on the east slope of the northern portion of the Braden Mountain site. Due to the lack of open water resources and the lack of roosting caves, gray bats are not likely to roost or forage on the Braden Mountain site.

Several species of state-listed small mammals are reported from Campbell and Scott Counties. Smoky, common, and southeastern shrews have are typically found in cooler, moist forests with a thick-leaf litter layer and moss-covered rocks, fallen logs, and other woody debris. These small mammals are usually found in association with creeks, streams, or moist areas. Southeastern shrews are less constrained by habitat requirements than other shrews and can be found in a variety of habitats. Most habitats in the RBWMA are suitable for these species, especially smoky and southeastern shrews.

Allegheny woodrats are typically found along rock outcrops, in caves or mines, usually in forested areas having a high degree of woody debris and leaf litter. There are no records of woodrats from the project site, however, suitable habitat for this species exists along the many forested highwalls and rock outcrops on the Braden Mountain site.

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Woodland jumping mice, hairy-tailed mole, and bog lemming exist in suitable habitats on the RBWMA. The species are usually associated with moist habitats. Jumping mice are found in forested or brushy areas along streams or the margins of wetland habitats. Hairy-tailed moles in the vicinity have been collected under decomposing logs in loose, moist soil (Allsbrooks et al. 1983). Bog lemmings have also been collected in similar habitats. These species are expected to exist in suitable habitats in the project area.

3.3.3 Aquatic Animals

Activities in the proposed mine permit area could affect several named perennial and intermittent streams that support aquatic life. A search of the TVA Regional Natural Heritage Project database indicates that several federally or state-listed species have been reported from Campbell and Scott Counties (Table 2). This section provides brief descriptions of the status of these species in the project area.

Table 2. Endangered, threatened, or otherwise listed aquatic animals reported from Campbell and Scott Counties, Tennessee.

Common Name	Scientific Name	State Status	Federal Status
	Molluscs		
Cumberland elktoe	*Alasmidonta atropurpurea*	Endangered	Endangered
Cumberlandian combshell	*Epioblasma brevidens*	Endangered	Endangered
Tan riffleshell	*Epioblasma florentina walkeri*	Endangered	Endangered
Green blossom pearlymussel	*Epioblasma torulosa gubernaculum*	Endangered	Endangered
Littlewing pearlymussel	*Pegias fabula*	Endangered	Endangered
Cumberland bean	*Villosa trabalis*	Endangered	Endangered
	Fish		
Emerald darter	*Etheostoma baileyi*	In Need of Management	-
Ashy darter	*Etheostoma cinereum*	Threatened	-
Arrow darter	*Etheostoma sagitta*	In Need of Management	-
Duskytail darter	*Etheostoma percnurum*	Endangered	Endangered
Cumberland johnny darter	*Etheostoma susanae*	Endangered	Candidate
Palezone shiner	*Notropis albizonatus*	Endangered	Endangered
Tippecanoe darter	*Etheostoma tippecanoe*	In Need of Management	-
Silverjaw Minnow	*Notropis buccatus*	Threatened	-
Rosyface Shiner	*Notropis rubellus rubellus*	In Need of Management	-
Blackside dace	*Phoxinus cumberlandensis*	Threatened	Threatened

The emerald darter, arrow darter, and blackside dace have all been recently reported in Terry Creek, a tributary to Elk Fork Creek, and in Straight Fork Creek and its Jake Branch tributary. The headwater portions of these streams drain portions of the proposed mine permit area. None of these species, or other listed aquatic species, have been reported

from streams within the proposed mine permit area, and none were found in field surveys of this area conducted during June 2002.

The emerald darter inhabits rocky pools and runs of the creeks and small rivers that make up the watersheds of the Big South Fork and Upper Cumberland Rivers (Etnier and Starnes 1993). On the Cumberland Plateau, this species is particularly susceptible to degradation of water quality resulting from siltation, toxic runoff, and acid mine drainage from coal mines and poor land use practices.

The arrow darter inhabits pools and runs in streams of slow-to-moderate current. High quality habitat includes have bedrock and rock rubble bottoms interspersed with areas of clean sand; such streams are usually cool and densely shaded by hemlock, rhododendron, or mountain laurel. The arrow darter is adapted to tolerate moderate levels of siltation; however, its range has probably been adversely impacted by heavy siltation following logging and surface mining and acid mine drainage from surface mines. The arrow darter's range in Tennessee is confined to the upper Cumberland River and some of the eastern tributaries to the Big South Fork on the Cumberland Plateau.

The blackside dace is found in about 30 separate streams in the upper Cumberland River system (primarily above Cumberland Falls) in Kentucky and Tennessee, including parts of Scott and Campbell Counties. It inhabits small upland streams with moderate flows and is generally associated with undercut banks and large rocks in relatively stable, well-vegetated watersheds with good riparian vegetation. The fish is not found in low-gradient silty streams or in high-gradient mountain tributaries. Habitat degradation from coal mining (acid mine drainage), natural low flows, and siltation from logging, road construction, agriculture, and human development are the primary threats to this species.

None of the remaining species listed in Table 2 have been recently reported in stream segments draining the proposed mine permit area. The only known locations in Scott or Campbell Counties for several of the species listed in Table 2 are within the main channel of the Big South Fork River. These species include the Cumberland elktoe, Cumberlandian combshell, tan riffleshell, littlewing pearlymussel, Cumberland bean, duskytail darter, and Tippecanoe darter. None of these species is likely to occur in streams potentially impacted by this action.

The green blossom pearlymussel formerly occurred in the Tennessee River system, including the Clinch River. It is considered likely to be extinct (NatureServe 2001). The palezone shiner formerly occurred in Cove Creek, but is now believed to be extirpated from Tennessee (Etnier and Starnes 1993). The only known extant populations of this species occur in the Little South Fork of the Cumberland River in southeast Kentucky and Paint Rock River in Alabama. Neither the green blossom pearlymussel nor the palezone shiner are likely to occur in streams within the project area.

The silverjaw minnow occurs in small creeks as well as large rivers with sand substrates. The last reported occurrence of this species in potentially affected streams was in Straight Creek in 1974. This species is considered on the verge of extirpation in the upper Cumberland drainage in Tennessee (Etnier and Starnes 1993).

The Cumberland johnny darter is known from short reaches of 16 small streams in the upper Cumberland system in Whitley and McCreary Counties in Kentucky, and two small streams in Tennessee: one in Scott County and one in Campbell County (O'Bara 1988, Laudermilk and Cicerello 1998). It is not known from streams in the Straight Creek, Cove Creek, or Elk Fork drainages, and is not likely to occur in any streams potentially impacted by this project.

The ashy darter is known from several tributaries to the New River near the project area. It is typically found in small to medium upland rivers with bedrock or gravel substrate and sluggish currents (Etnier and Starnes 1993). It is also known from a few other tributaries to the Cumberland River as well as a few tributaries to the Tennessee River in Tennessee and Kentucky.

The rosyface shiner typically inhabits large creeks and small rivers with clean water and substrates consisting of rubble, boulder, or bedrock. Although this species is more tolerant of siltation than other related species, it is particularly susceptible to degradation of water quality resulting from siltation, toxic runoff, and acid mine drainage from coal mines and poor land use practices. The subspecies of rosyface shiner that occurs on the Cumberland Plateau (*Notropis rubellus rubellus*) is particularly threatened by habitat degradation.

3.4 Surface Water and Aquatic Ecology

The proposed mine area is located within the Cumberland Mountains subprovince of the Cumberland Plateau physiographic province. Larger streams in this subprovince tend to have moderate to low gradients and flow in well defined valleys. Examples include Elk Fork Creek, Buffalo Creek, and Cove Creek. Smaller streams drain mountain slopes and tend to have moderate to high gradients and a substrate of boulders, cobble, and gravel. Many streams in the Cumberland Mountains have been degraded by siltation and acid mine drainage from unreclaimed or poorly reclaimed coal mines. This situation has ameliorated somewhat in recent years. Otherwise, waters in the subprovince tend to be soft and low in dissolved nutrients.

The proposed mine site is located within the headwaters of three watersheds: Buffalo Creek, Elk Fork Creek, and Straight Fork. A portion of the haul roads within the proposed mine permit area are within the headwaters of a fourth watershed, Cove Creek. Buffalo Creek, through its Rockhouse Fork, Collins Branch, Lick Branch, and Crabtree Branch tributaries, drains the west side of the site. Buffalo Creek is a tributary to the New River. Elk Fork Creek, a tributary to Clear Fork Cumberland River, drains the northeast portion of the site via its Terry Creek, Stillhouse Branch, Frogpond Hollow, and Hudson Branch tributaries. Much of the southern portion of the site drains to Straight Fork as well as its Jake Branch and Cross Branch tributaries. Straight Fork is a tributary to Buffalo Creek.

Water use classifications of the streams draining the proposed mine permit area are fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. Cove Creek has the additional use classification of industrial and domestic water supply. There are no surface water users within or adjacent to the proposed mine permit area. The closest domestic groundwater resource is about a mile from the proposed mine site and much lower than potentially affected coal seams.

A 3.9 mile stretch of Elk Fork Creek near Jellico is listed on the state of Tennessee's 2002 draft Clean Water Act 303(d) list as partially supporting use classifications (TDEC 2002). The causes of these exceedances of water quality standards are siltation and other habitat alterations resulting from abandoned mining. Straight Fork Creek and its tributaries are also listed on the 303(d) list as partially supporting use classifications. The causes of these

exceedances of water quality standards are pH and other habitat alterations, resulting from resource extraction and habitat modification.

The portions of these streams within the mine permit area are intermittent or wet weather conveyances which are dry most of the year. Five of the eight intermittent streams were flowing or wet during June 2002. Evidence of aquatic life (caddisflies, mayflies, chironomids was present during June 2002 in an intermittent tributary to Frogpond Hollow on the northeast slope of the northern portion of Braden Mountain, and in an intermittent tributary to Jake Branch on the east slope of the southern portion of Braden Mountain. The Frogpond Hollow tributary flows from several separate channels which converge on an orphan mine bench and the Jake Branch tributary flows from a pond on an orphan mine bench. A few ponds, some of which are ephemeral, occur on orphan (e.g., abandoned) mine benches within the mine permit area. These ponds are occupied by aquatic insects and several species of amphibians.

The aquatic community in Cove Creek at mile 18.2 (about one mile above Cove Lake) was sampled by TVA in May 2000. The fish assemblage, comprised of 15 species, was rated fair compared to what would be expected in such a stream under ideal conditions; the benthic assemblage (bottom-dwelling invertebrates) was rated good.

Results of surface water quality monitoring within potentially affected streams are presented in the 1999 mine permit application (Gatliff Coal Company 1999) and in Cumulative Hydrologic Impact Assessments prepared by OSM (OSM 1999). Water quality in these streams is described as reasonably good. Collins Branch, Rockhouse Fork, Cross Branch, and Jake Branch show impacts from past coal mining based on moderate to high concentrations of sulfate (up to 150 mg/l). pH levels in sampled streams are near-neutral (5.5 – 8.0). Total dissolved solids, dissolved iron, and dissolved manganese levels are below Environmental Protection Agency (EPA) standards except for the Straight Fork watershed, where both total dissolved solids and dissolved manganese standards are exceeded.

3.5 Managed Areas and Ecologically Significant Sites

The land surface of the Braden Mountain area is within the 43,620-acre Royal Blue Wildlife Management Area owned by the TWRA. TWRA purchased the area in 1991 after leasing it for many years from several previous owners. The WMA is managed for hunting and other forms of outdoor recreation including wildlife observation, off-road vehicle operation, hiking, and horse riding (TWRA 2001). Several habitat management projects have been undertaken in cooperation with organizations such as Quail Unlimited, the National Wild Turkey Federation and the State Division of Mine Reclamation.

Popular game species on RBWMA are white-tailed deer, wild turkey, ruffed grouse, raccoon, and squirrel. TWRA began releasing elk on RBWMA in 2000 as part of an elk restoration project centered on the Cumberland Mountains and adjacent parts of the Cumberland Plateau.

The Smoky Mountain segment of the Cumberland Trail, a linear state park, runs through RBWMA. At its closest point, the Cumberland Trail is about 7 miles from the proposed mine permit area.

RBWMA is also one of two publicly owned tracts within the Southern Cumberland Mountains Important Bird Area (IBA), which encompasses 141,000 acres in four counties (National Audubon Society 2002a). The Southern Cumberland Mountains IBA is notable for its high populations of the cerulean warbler and the golden-winged warbler, as well as the presence of many other species of migrant and resident birds. The IBA program is an international effort to identify the most important areas for maintaining bird populations and focus conservation efforts on those sites (National Audubon Society 2002b). It is administered in the U.S. by the National Audubon Society and in Tennessee is administered by TWRA in cooperation with the Tennessee Ornithological Society and two Audubon Chapters.

The Cumberland Forest Public Hunting Area (PHA), a mostly forested area of 75,000 acres owned by International Paper, adjoins much of the west side of RBWMA. PHAs are managed through a cooperative agreement between land holding companies and TWRA. Forest lands owned by International Paper are managed to provide lumber, paper, clean water, improve wildlife habitats and to create recreational opportunities for the public. In August 2002, TWRA announced its acquisition of this property through a joint effort with The Conservation Fund, Renewable resources Inc., and International Paper.

Stinking Creek, a tributary to the Clear Fork Cumberland River, is listed on the National Rivers Inventory maintained by the National Park Service. It is described in the Inventory as a rural, scenic stream flowing through the unique Cumberland Black geologic formation (NPS 2002). The headwaters of Stinking Creek are about 2 miles east of the project area. None of the proposed mine permit area drains to Stinking Creek.

3.6 Visual Resources

The physical, biological, and cultural features of an area combine to make the visual landscape character both identifiable and unique. Scenic integrity indicates the degree of unity or wholeness of the visual character. Scenic attractiveness is the evaluation of outstanding or unique natural features, scenic variety, seasonal change, and strategic location. Where and how the landscape is viewed will affect the more subjective perceptions of its aesthetic quality and sense of place. Views of a landscape are described in terms of what is seen in foreground, middleground, and background distances. In the foreground, an area within one half mile of the observer, details of objects are easily distinguished in the landscape. In the middleground, normally between a mile and four miles from the observer, objects may be distinguishable but their details are weak and they tend to merge into larger patterns. Details and colors of objects in the background, the distant part of the landscape, are not normally discernible unless they are especially large and standing alone. The impressions of an area's visual character can have a significant influence on how it is appreciated, protected, and used.

Landscape character gives a geographical area its visual and cultural image, and consists of the physical, biological, and cultural attributes that makes each landscape identifiable and unique. The general landscape character of the proposed mine permit area is described in the following paragraphs.

The northern portion of the Braden Mountain area is situated between Wesley Gap and Braden Gap. It is heavily wooded, limiting viewsheds to adjacent land areas. Elevations range from about 1950 to 2700 feet at the site of a former lookout tower along the highest ridge. Access to the site is from the south off of Highway 63 at Poteet Gap or from the east

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off of Highway 297 at Elk Gap. Both access toads are unimproved; traffic along these roads is limited to seasonal hunters, off-road vehicles, and other recreation users. There are no residents in the immediate mine area; a few occupied houses occur along Highway 297 near Elk Gap.

Narrow abandoned surface mines surround much of the area at about the 2300 foot contour. These mines are mostly revegetated and the highwalls are generally less than 30 feet tall. The remainder of the area is hardwood forest with grass and shrub understory. The elevations along the ridge are comparable or greater in height than surrounding ridges within a four-mile radius. Scenic attractiveness is common. Scenic integrity is moderate.

The southern portion of Braden Mountain is situated between Limestone Ridge to the east and Gunsight Mountain to the west. Elevations range from approximately 2000 to 2650 feet at the highest point on Braden Mountain. Access to the site is via the same unimproved roads used for the northern portion of Braden Mountain.

Narrow, mostly revegetated, abandoned surface mines surround parts of the site at about the 2300 foot contour. Larger, partially revegetated abandoned surface mines occur at about the 2000 foot contour on the southern edge of the site. These larger mines have tall sheer rock highwalls that contrast with the surrounding steep slopes. Views from this area are minimal due to heavy deciduous vegetation. Scenic attractiveness is common. Scenic integrity is moderate.

3.7 Cultural Resources

East Tennessee has been an area of human occupation for the last 12,000 years. Human occupation of the area is generally described in five broad cultural periods: Paleo-Indian (11,000-8,000 BC), Archaic (8000-1600 BC), Woodland (1600 BC-AD 1000), Mississippian (AD 1000-1700), and Historic (AD 1700- to present). Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on flood plains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. European interactions with Native Americans in this area began in the 17th and 18th centuries associated with the fur trading industry. Euro-American settlement increased in the early 19th century as the Cherokee were forced to give up their land. Campbell County was created by the Tennessee General Assembly in 1806 (Baird et al. 1998). Scott County was created in 1849 (Binnicker 1988).

TVA Cultural Resources Staff has defined the area of potential effect (APE) as the approximately 900 acres associated with the proposed coal mining activity. This APE includes the 664.5 acre proposed mine permit area, as well as areas not included in the mine permit area but bounded by proposed mine features such as sediment basins and access roads.

No archaeological surveys had been previously conducted in the project area. Given the high potential for archaeological resources associated with caves and rockshelters in the Cumberland Plateau area, an archaeological reconnaissance was conducted to determine if any areas within the APE had a potential for archaeological sites. Based on the reconnaissance survey, 400 acres of land were then subjected to Phase I Archaeological surveys to determine if any sites eligible for listing in the National Register of Historic Places (NRHP) were present within the APE. The Phase I Archaeological survey, which

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included shovel testing, was conducted in June 2002 (Pietak and Holland 2002). Three isolated finds, none of which are considered potentially eligible for listing on the NRHP, were observed. The survey also identified two rockshelters with a potential for archaeological resources to be present. Phase II testing was conducted at these rockshelters in September of 2002. Archaeological material indicative of brief prehistoric occupation was collected at each of the rockshelters, which were designated as archaeological sites 40CP134 and 40CP135. The limited quantity of material yielded insufficient data to make either rock shelter eligible for listing in the NRHP.

There are 4 historic properties listed on the National Register of Historic Places in Campbell County and 5 in Scott County. None of these properties are located near the project area.

4 ENVIRONMENTAL CONSEQUENCES

The following sections describe the likely environmental consequences resulting from the proposed action. The potential cumulative impacts of the resulting coal mining are described in Final Environmental Impact Statement, Comprehensive Impacts of Permit Decisions Under the Tennessee Federal Program (OSM 1985). In its notice of adoption of this FEIS (55 Federal Register 23338, June 7, 1990), TVA determined that the potential cumulative environmental impacts of coal leasing were adequately assessed. Additional information on potential cumulative hydrologic impacts is presented in the Cumulative Hydrologic Impact Assessments prepared by OSM (OSM 1999) and described below.

Under the No Action Alternative, the leasing and surface mining of coal in the Braden Mountain area would not occur and royalties on the TVA coal would not be paid. The area would continue to be managed as part of Royal Blue Wildlife Management Area by TWRA.

4.1 Vegetation

The proposed action would result in the disturbance of vegetation on about 527 acres of the 664.5 acre mine permit area. The proposed mine permit area is a mixture of recently harvested forest, dominated by saplings and shrubs, abandoned mines in various stages of revegetation ranging from herbacious and shrub communities to pole-sized forest, and more mature forest dominated by oak-hickory and mixed mesophytic forest types.

Although no plant communities of state, regional, or global significance occur within the mine area, the proposed action would result in long term changes to site vegetation. Vegetation within areas to be mined, as well as fill areas and sediment ponds, would be removed. As the area is reclaimed, ground cover, shrubs, and trees will be replanted. Most of the area will be replanted with a mixture of grasses and legumes such as orchardgrass, annual rye, ladino clover, and red clover.. Portions of the area will be planted with native warm season grassess, in blocks of shrub/tree mixes, or in blocks of deciduous trees dominated by oaks. Following the completion of reclamation activities and bond release, the vegetation on the mine site would be managed by TWRA. In the absence of active management, areas of grass and herbaceous cover would eventually revert to forest.

Several invasive, non-native plant species are already established in RBWMA, partly as a result of previous surface mine reclamation activities. Such species considered to present a severe threat to native plant communities such as sericea lespedeza and autumn olive

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would not be used in revegetating the proposed mine. The proposed action would not result in the introduction of any invasive species to RBWMA.

4.2 Wildlife

Under the proposed action, about 527 acres would be modified during construction and operation of the mine. Haul roads would occupy 86 acres; most of the haul roads are existing, and impacts of widening these roads would be minor. Of the remaining 441 acres, about 100 acres are early successional habitats, at least 60 acres are abandoned mine areas with early to mid-successional habitats, and the remainder more mature forest.

Clearing and mining activities would result in some direct mortality of slow-moving animals and the displacement of more mobile species into adjacent habitats as mining activities proceed through the mine area over the course of 7.4 years. This progressive movement of coal removal activities and the subsequent incremental reclamation of the disturbed areas would reduce impacts to local populations of wildlife.

Results of restoration studies performed on reclaimed mines at nearby Brushy and Walnut Mountains (TVA 1981), as well as other studies elsewhere, indicate that wildlife quickly move into reclaimed habitats. Populations of small mammals moved into reclaimed areas within 2 months of planting new vegetation and breeding aggregations of amphibians were noted within settling ponds within the first year. These areas were quickly repopulated by species that favor early successional habitats. Species that favor forested habitats would later move into the reclaimed areas as the postmining vegetation reverts to woodland habitats. The previously approved mine reclamation plan was developed in cooperation with TWRA to assist in meeting their wildlife management goals for the Braden Mountain area. Specific reclamation activities designed to enhance wildlife populations on the reclaimed mine include revegetation of portions of the area with native warm season grasses, retaining sediment basins, planting blocks of mixed trees and shrubs, and planting blocks of hardwood trees. The block hardwood plantings, in addition to accelerating reforestation, would provide connectivity between forested areas downslope from the mine and the hilltop and sideslope areas where coal removal would be by augering.

The proposed action would result in direct impacts to terrestrial animal populations in the project area. However, due to the large amounts of similar habitat adjacent to the project, impacts to terrestrial wildlife in the region would be temporary and insignificant. The project is not expected to result in significant cumulative impacts to terrestrial animal communities, increase populations of exotic or invasive terrestrial animals, or result in significant adverse impacts to migratory birds in the region.

4.3 Endangered and Threatened Species

4.3.1 Plants

One occurrence of a state-listed plant species (goldenseal) was identified on the northern portion of Braden Mountain. At least 116 additional occurrences of this species are known from elsewhere in Tennessee. Therefore, the potential loss of this individual would not significantly impact the viability of this species in Tennessee.

Although areas of marginally suitable habitat were identified for some other state-listed plants reported from the surrounding vicinity, no occurrences of such species (with the exception of the goldenseal mentioned above) were identified during field surveys.

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In summary, the proposed action would not result in significant impacts to state-listed plant species, and no federally listed plants would be affected.

4.3.2 Terrestrial Animals

Under the proposed, action TVA would enter a lease agreement with a coal company that would result in surface mining of coal on Braden Mountain. This would result in the modification of about 527 acres of forested and early successional habitats over a 7.4 year period. Of the 22 protected species of terrestrial animals reported from Scott and Campbell Counties, 16 are known to exist or potentially exist on the project site.

The red-cockaded woodpecker, Swainson's warbler, Bewick's wren, hellbender, and Black Mountain dusky salamander were removed from consideration due to the lack of or the limited presence of suitable habitat for these species on the site. Potential hibernating sites for the Indiana bat and the gray bat are provided by abandoned mine portals in the mine permit area. One of these portals was inspected in January 1999 and determined to be unsuitable for use by hibernating Indiana bats or gray bats. No evidence of summer use by gray bats was observed during inspections in the summer of 2002. The only activities proposed in the immediate vicinity of a second portal on the northwest slope of the southern portion of Braden Mountain are sediment basin and access road construction. These activities would not significantly disturb the portal. A third portal, on the east slope of the northern portion of Braden Mountain has a small, mostly collapsed opening and does not appear suitable for use by the Indiana bat or gray bat.

The remaining 16 species are known to exist or potentially exist in early successional and forested habitats in the project area. Construction and operation of the mine could affect individual specimens of most of these species. However, impacts to the species as a whole are expected to be temporary as most of these species would disperse into nearby similar habitats.

Once reclamation activities begin, species that breed or forage in early successional habitats such as four-toed salamander, golden-winged warbler, barn owl, big-eared and small-footed bats, southeastern shrew, hairy-tailed mole, and bog lemming would re-colonize the area. Local populations of some of these species, particularly the golden-winged warbler, would increase, and the reclaimed mine would provide suitable habitat for this warbler for many years. Forest dwelling species would experience a short-term reduction in habitat and local populations of some of these species would be slightly reduced. Up to 69 pairs of cerulean warblers would be affected within the area of surface mining and fills; this number represents a small fraction of the population of this species in the RBWMA as well as in the Cumberland Mountains. Portions of the mined area would be reforested during reclamation and these areas would provide suitable habitat for many forest-dwelling species. Due to the large amounts of suitable habitats nearby, impacts to these species would be temporary and insignificant and their population viability on RBWMA would not be affected.

During the review of the OSM Environmental Review of the Gatliff Coal permit, USFWS, TVA, and TWRA determined that there would be no significant impacts to any federally listed species if certain commitments were followed. These commitments are listed in the FONSI issued by TVA in 1999 (TVA 1999) and incorporated into the currently proposed action. They are designed to establish specific reclamation activities to protect the

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endangered Indiana bat and other species of wildlife. With the implementation of these measures, the proposed action is not likely to adversely effect threatened and endangered terrestrial animals.

4.3.3 Aquatic Animals

Of the nine endangered, threatened, or otherwise sensitive aquatic species potentially occurring in the project area, only the blackside dace, the arrow darter, and the emerald darter are present in streams potentially impacted by mining Braden Mountain. These species are reported from Terry Creek near its confluence with Elk Fork Creek, and from the Straight Fork system. The Terry Creek headwaters consist of three streams whose surface water is supplied by drainage from the Braden Mountain site; Stillhouse Branch, Frogpond Hollow, and Hudson Branch. Straight Fork Creek is supplied by several streams that drain the Braden Mountain area, including Jake Branch, Cross Branch, and Straight Fork Creek.

Potential impacts to these three streams resulting from the proposed action are discussed in the Cumulative Hydrologic Impact Assessment (CHIA) prepared by Gatliff Coal Company in the previous review of this project. These potential impacts are discussed in CHIA No. 101, Cumulative Impact Area (CIA) No. 10, Subarea No. 6B (Elk Fork Creek system) and CHIA No. 84, CIA No. 8, Subarea No. 6B (Straight Fork). This analysis considers all existing and anticipated mining operations and addresses potential cumulative hydrologic impacts to CIA 10, Subarea 6B (Elk Fork Creek), and CIA No. 8, Subarea 6B (Straight Fork Creek).

This assessment concludes that while there is slight potential for acid/toxic drainage, and increased sediment loads into Terry Creek, Stillhouse Branch, Frogpond Hollow, and Hudson Branch in the Elk Fork system, and Jake Branch, Cross Branch, and Straight Fork in the Straight Fork system, the effects would be minimized by measures to be implemented during active mining, and during reclamation of the site. Surface-water monitoring of these streams, and of the settling basins above these streams, would be conducted in accordance with NPDES permit requirements to ensure that water quality impacts to receiving streams are minimized

This hydrological analysis indicates that water quality in these streams should remain within acceptable limits and would not significantly exceed conditions favored by these species. Therefore, this proposed mining activity would likely result in only short-term, insignificant impacts to aquatic life in Terry Creek and Straight Fork, including blackside dace, arrow darter, and emerald darter.

Construction of the haul roads would have potential to impact populations of blackside dace, arrow darter, and emerald darter in the Straight Fork system. These potential impacts would result primarily from run-off of silt generated by road construction and maintenance activities.

Construction and maintenance of the haul road would be performed in accordance with appropriate Best Management Practices. Use of measures to control run-off from the haul road, and to minimize ground disturbance during construction would likely result in only insignificant impacts to blackside dace, arrow darter, and emerald darter in Straight Fork.

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4.4 Surface Water, Groundwater, and Aquatic Ecology

Potential impacts to surface water and aquatic ecology resulting from the proposed mining activities include increased sediment in surface runoff, acid/toxic drainage, altered flow regimes, and impacts to streams from construction of hollow fills. Potential impacts to groundwater include changes in availability and flow regimes, and changes in water quality.

Runoff from the proposed mine site would drain into three watersheds (Straight Fork, Elk Fork, and Buffalo Creek) and runoff from a part of the proposed haul roads would drain into a fourth watershed (Cove Creek). OSM (1999) has prepared Cumulative Hydrologic Impact Assessments (CHIAs) for these four watersheds. No surface water users or groundwater users would be affected in any of the four watersheds.

Measures incorporated into the mine plan to minimize hydrologic impacts include use of hay bales and filter fabric fence, installation of sediment basins with controlled discharges, periodic sampling of water in sediment basins and chemical treatment as necessary. Although the majority of the strata to be disturbed by mining exhibit a positive net acid base accounting (i.e., have sufficient buffering capacity to prevent acid production), the coal seams are potentially acid producing. The proposed mine plan includes a hydrologic reclamation plan and a toxic material handling plan. Mined coal would be promptly removed from the site and overburden would be blended when backfilled to minimize potential acidic problems. Sediment in basins would be sampled prior to removal and treated according to the mine plan. Sediment basins would be retained following reclamation at the discretion of TWRA.

Groundwater quality in the proposed mine area is highly variable and iron and manganese concentrations sometimes exceed EPA standards for public water systems. Any impacts to groundwater quality would be localized and not affect groundwater users.

The CHIAs show that impacts to surface water would be insignificant. Within each of the four watersheds, there would be a small increase in sediment loading during mining. Following mining, the sediment yield load value would decrease to levels similar to or less than pre-mining values. pH values would be unchanged or slightly decrease; the greatest change would occur in the Elk Fork watershed, where the minimum anticipated pH would be 7.3, a near-neutral value within acceptable EPA limits for domestic water supplies and freshwater aquatic life. Increases in total dissolved solids, dissolved iron, and dissolved manganese levels would be small and anticipated concentrations would remain within EPA standards in the Elk Fork and Buffalo Creek watersheds.

Total dissolved solids and dissolved manganese concentrations in the Straight Fork watershed presently exceed EPA standards under flow conditions; these problems are caused in large part by drainage from old mine openings in the Big Mary coal seam. The proposed mining, which includes reclamation of orphan mine areas, would not result in further degradation of Straight Fork.

A few short segments of intermittent streams and wet weather conveyances, as well as a few small ponds, would be directly impacted by mining activities. Stream channels would be restored during reclamation, and no long-term changes in runoff are anticipated. Sediment basins would replace habitat currently present in ponds. Overall impacts to aquatic ecology would be insignificant.

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4.5 Managed Areas and Ecologically Significant Sites

The proposed action would result in the operation of a coal surface mine within the Royal Blue Wildlife Management Area. This would affect wildlife habitat and recreational use, including hunting and off-road vehicle use, within the proposed mine permit area. The proposed mine permit area comprises a small portion of RBWMA (less than 2%) and the revegetation plan was developed with the assistance of TWRA. The main roads into the area from Highway 63 at Poteet Gap and from Highway 297 at Elk Gap would remain open to the public. The Gunsight Mountain road, which passes through the southern portion of the Braden Mountain area, may be closed during active mining operations. Impacts to the RBWMA are expected to be temporary and insignificant.

No impacts to the Cumberland Forest Public Hunting Area, or to Stinking Creek, listed on the National Rivers Inventory, are anticipated. Impacts to the Southern Cumberland Mountains Important Bird Area, which includes RBWMA and other nearby areas, are expected to be temporary and insignificant.

4.6 Visual Resources

Visual consequences are examined in terms of visual changes between the existing landscape and proposed actions, sensitivity of viewing points available to the general public, their viewing distances, and visibility of proposed changes. Scenic integrity indicates the degree of intactness or wholeness of the landscape character. These measures help identify changes in visual character based on commonly held perceptions of landscape beauty, and the aesthetic sense of place. The foreground, middleground, and background viewing distances were previously described in the affected environment section.

Site preparation and initial mining activities would adversely impact the visual landscape character of the proposed mine permit area by removing forest cover, modifying landforms, and increasing truck traffic along local access roads. Some fill areas would have a series of stair-stepped plateaus with somewhat gentler slopes than presently exist. These features would increase adverse visual contrast, while reducing unity, coherence, and harmony in the landscape during the initial construction period. Scenic integrity would be lower. Most of these visual impacts would lessen over time as the area is revegetated.

Some proposed mining operations would be visible to recreational users of the Braden Mountain and Limestone Ridge areas of RBWMA. Portions of the mine area may also be briefly visible to motorists on Highways 63 and 297, as well as Interstate 75. The mine area would be in the middleground or background of views from these roads, and visual details would be weak. Views from these highways already include highwalls of unreclaimed mines, as well as elements such as communication towers and, on Interstate 75, billboards. Overall visual impacts would be insignificant and mostly short-term.

4.7 Cultural Resources

A Phase I Cultural Resource survey of the APE identified two rockshelters with a potential to contain archaeological sites. Further investigations of these areas were conducted and two archaeological sites were identified (40CP134 and 40CP135). Material from these sites was considered insignificant and neither site is recommended as potentially eligible for the NRHP. TVA has determined that the proposed project would have no effect on any historic properties on or eligible for NRHP listing. A letter of TVA's findings and determinations was

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sent to the Tennessee State Historic Preservation Officer on October 18, 2002. Similar letters were sent to the Eastern Band of the Cherokee Indians on October 23, 2002.

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5.2 Preparers

Preparer	Contribution
John T. Baxter, Jr.	Endangered and Threatened Species
J Leo Collins	Vegetation, Endangered and Threatened Species
Nancy D. Fraley	Managed Areas and Ecologically Significant Sites
Groton, James G. (contractor)	Vegetation, Endangered and Threatened Species
Travis Hill Henry	Wildlife, Endangered and Threatened Species
Charles P. Nicholson	EA Compilation, Wildlife, Endangered and Threatened Species
George E. Peck	Aquatic Ecology
W. Chett Peebles	Visual Resources
Erin E. Pritchard	Cultural Resources
Carolyn L. Wells	Vegetation, Endangered and Threatened Species
Richard W. Yarnell	Cultural Resources

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Appendix 1

Endangered, threatened, or otherwise listed plant species known to occur in Campbell and Scott Counties, Tennessee.

Common name	Scientific name	Federal status	State status
Alabama grapefern	*Botrychium jenmanii*		Threatened
Alder-leaf buckthorn	*Rhamnus alnifolia*		Endangered
American barberry	*Berberis canadensis*		Special Concern
Barbara buttons*	*Marshallia grandiflora*		Endangered
Bristle fern	*Trichomanes boschianum*		Threatened
Canada lily	*Lilium canadense*		Threatened
Capillary beakrush	*Rhynchospora capillacea*		Endangered-P[1]
Climbing fumatory	*Adlumia fungosa*		Threatened
Cumberland rosemary	*Conradina verticillata*	Threatened	Threatened
Cumberland sandwort	*Arenaria cumberlandensis*	Endangered	Endangered
False foxglove*	*Aureolaria patula*		Threatened
Ginseng	*Panax quinquefolius*		Special Concern-CE
Goldenseal	*Hydrastis canadensis*		Special Concern-CE[2]
Green-and-gold	*Chrysogonum virginianum*		Threatened
Kentucky rosin-weed	*Silphium wasiotense*		Endangered
Lady-slipper*	*Cypripedium kentuckiense*		Endangered
Meehan mint	*Meehania cordata*		Threatened
Northern white cedar	*Thuja occidentalis*		Special Concern
Ozark bunchflower	*Melanthium woodii*		Endangered
Pale corydalis	*Corydalis sempervirens*		Endangered
Panic-grass*	*Panicum ensifolium*		Special Concern
Pink lady-slipper	*Cypripedium acaule*		Endangered-CE[3]
Pondweed*	*Potamogeton tennesseensis*		Threatened
Rockcastle aster	*Aster saxicastellii*		Endangered
Roundleaf bitter-cress	*Cardamine rotundifolia*		Special Concern
Roundleaf fameflower	*Talinum teretifolium*		Threatened
Sandreed grass*	*Calamovilfa arcuata*		Endangered
Smoothleaf honeysuckle	*Lonicera dioica*		Special Concern
Southern rein orchid	*Platanthera flava var flava*		Special Concern
Spike-rush*	*Eleocharis intermedia*		Special Concern
Spotted coral-root	*Corallorhiza maculata*		Threatened
Stonecrop*	*Sedum nevii*		Endangered
Sullivantia	*Sullivantia sullivantii*		Endangered
Sweet-fern	*Comptonia peregrina*		Endangered
Tawny cotton-grass	*Eriophorum virginicum*		Threatened
Virginia spiraea	*Spiraea virginiana*	Threatened	Endangered
White snakeroot*	*Ageratina luciae-brauniae*		Threatened
Wild ginger*	*Hexastylis contracta*		Special Concern
Witch-alder*	*Fothergilla major*		Threatened
Wood lily	*Lilium philadelphicum*		Endangered

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*The common name listed is routinely applied to more than one member of this genus.
[1] Endangered-P -- endangered, potentially extirpated.
[2] Special Concern-CE = special concern due to commercial exploitation.
3 Endangered-CE = endangered due to commercial exploitation.

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BIRDS OF CONSERVATION CONCERN 2002

U.S. Fish and Wildlife Service
Division of Migratory Bird Management
Arlington, Virginia

December 2002

BIRDS OF CONSERVATION CONCERN 2002

Prepared by

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Division of Migratory Bird Management
Arlington, Virginia

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Appendix B. Summary of Species Occurrences on BCR, USFWS Region, and National Lists in BCC 2002, Arranged Alphabetically by Common Group Name.

Name, Common	BCRs	USFWS Regions	National
Akekee	67	1(b)	X
Akikiki	67	1(b)	X
Alauahio, Maui	67	1(b)	X
Albatross, Black-footed	5, 32, 67, 68	1(a,b,c), 7	X
Albatross, Laysan	67, 68		
Amakihi, Hawaii	67	1(b)	
Amakihi, Kauai	67	1(b)	
Amakihi, Oahu	67	1(b)	
Ani, Smooth-billed	31	4(a)	
Anianiau	67	1(b)	X
Apapane	67	1(b)	X
Auklet, Cassin's	32		
Auklet, Whiskered	1	7	X
Avocet, American	9		
Beardless-Tyrannulet, Northern	34, 36, 37	2	
Becard, Rose-throated	36	2	
Bittern, American	11, 12, 31, 37	3	
Blackbird, Rusty	22, 24, 28, 29	3	
Blackbird, Tricolored	9, 15, 32, 33	1(a)	X
Black-Hawk, Common	34, 35	2	
Bobolink	12, 13, 23	3, 6	
Booby, Brown	69	4(b)	
Booby, Masked	69	4(b)	
Booby, Red-footed	69	4(b)	
Bunting, Lark	18, 33, 34, 35, 36	2	
Bunting, McKay's	1, 2	7	X
Bunting, Painted	20, 21, 26, 27, 31, 35, 36, 37	2, 4(a)	X
Bunting, Varied	20, 34, 35, 36	2	
Chickadee, Black-capped	28		
Chuck-will's-widow	22, 25, 27, 28, 29, 31	3, 4(a)	X
Coot, Caribbean	69	4(b)	
Cormorant, Red-faced	1, 2		
Crake, Spotless	68	1(c)	X
Crake, Yellow-breasted	69	4b	
Crossbill, Red	28		
Cuckoo, Black-billed	11, 13, 17, 22, 23, 28	3, 6	X
Cuckoo, Mangrove	31	4(a)	
Cuckoo, Yellow-billed	5, 9, 10, 16, 32, 33, 34, 35	1(a), 2	X
Curlew, Bristle-thighed	2, 67, 68	1(b,c), 7	X
Curlew, Long-billed	5, 9, 10, 11, 17, 18, 19, 21, 32, 33, 35, 36, 37	1(a), 2, 4(a), 6	X
Dickcissel	17, 22, 23, 36	3, 6	X

Dowitcher, Short-billed	2, 4, 5, 12, 22, 23, 27, 31, 32, 37	1(a), 3, 7	X
Duck, Masked	69	4(b)	
Duck, Ruddy	69	4(b)	
Dunlin	3	7	
Eagle, Golden	9, 10, 16, 17	6	
Egret, Reddish	27, 31, 37	2, 4(a)	X
Elepaio	67	1(b)	X
Falcon, Peregrine	1, 2, 3, 4, 5, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 69	1(a), 2, 3, 4(a,b), 5, 6, 7	X
Falcon, Prairie	9, 10, 16, 17, 18, 32	1(a), 6	X
Fantail, Rufous	68	1(c)	
Flicker, Gilded	33, 34	2	
Flycatcher, Acadian	22, 23, 25, 28	3	
Flycatcher, Buff-breasted	34	2	
Flycatcher, Olive-sided	5, 14, 15, 28	1(a), 4(a), 5	X
Flycatcher, Puerto Rican	69	4(b)	
Flycatcher, Scissor-tailed	19, 21, 25	2	X
Frigatebird, Lesser	68		
Frigatebird, Magnificent	31, 69	4(b)	
Fruit-Dove, Crimson-crowned	68		
Fruit-Dove, Many-colored	68	1(c)	X
Fruit-Dove, Mariana	68	1(c)	
Godwit, Bar-tailed	1, 2, 3	7	X
Godwit, Hudsonian	2, 4, 11, 13, 14, 19, 21, 22, 23, 25, 26, 30, 37	2, 3, 4(a), 5, 7	X
Godwit, Marbled	2, 5, 9, 10, 11, 12, 13, 16, 17, 22, 23, 26, 27, 30, 31, 32, 33, 37	1(a), 3, 4(a), 5, 6, 7	X
Golden-Plover, American	2, 3, 4, 9, 10, 17, 18, 19, 21, 37	2, 6, 7	X
Golden-Plover, Pacific	2, 67, 68	1(b,c), 7	X
Goldfinch, Lawrence's	32, 33	1(a)	X
Goshawk, Northern	5, 34		
Ground-Dove, Common	27, 31		
Ground-Dove, Friendly	68	1(c)	X
Ground-Dove, White-throated	68	1(c)	
Harrier, Northern	11, 16, 18, 19, 21, 35, 36, 37	2, 6	X
Hawk, Ferruginous	9, 10, 11, 16, 17, 18, 34, 35	2, 6	X
Hawk, Gray	34	2	
Hawk, Harris's	36		
Hawk, Short-tailed	27, 31	4(a)	

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Hawk, Swainson's	9, 10, 11, 16, 19, 32, 36	1(a), 3, 6	X
Hawk, White-tailed	37	2	
Heron, Little Blue	19, 21, 25, 26, 27, 31	4(a)	X
Honeyeater, Wattled	68		
Hummingbird, Broad-billed	34	2	
Hummingbird, Buff-bellied	36, 37	2	
Hummingbird, Costa's	34		
Hummingbird, Lucifer	34, 35	2	
Hummingbird, Rufous	5, 15		X
Ibis, White	31, 37		
Iiwi	67	1(b)	X
Jay, Pinyon	16		
Kestrel, American	25, 27, 31		
Kite, Mississippi	19, 26		
Kite, Swallow-tailed	25, 26, 27, 31, 37	2, 4(a)	X
Kittiwake, Red-legged	1	7	X
Knot, Red	5, 27, 30, 31, 32, 33, 37	1(a), 2, 4(a), 5	X
Koel, Long-tailed	68		
Lark, Horned	5	1(a)	X
Limpkin	27, 31, 69	4(a,b)	X
Longspur, Chestnut-collared	11, 16, 17, 18, 19, 20, 21, 34, 35, 36	2, 6	X
Longspur, McCown's	10, 11, 17, 18, 19, 20, 35, 36	2, 6	X
Longspur, Smith's	3, 19, 21, 22, 24, 25, 26	2, 4(a), 7	X
Loon, Red-throated	2		
Loon, Yellow-billed	2, 3, 5	7	X
Lorikeet, Blue-crowned	68		
Mao	68		
Murrelet, Ancient	1, 2		
Murrelet, Kittlitz's	1, 2, 5	7	X
Murrelet, Marbled	1, 2, 5	7	X
Murrelet, Xantus's	32	1(a)	X
Myzomela, Cardinal	68		
Myzomela, Micronesian	68		
Noddy, Blue-gray	67, 68	1(b, c)	
Nuthatch, Brown-headed	25, 27, 31	2, 4(a)	X
Nuthatch, Pygmy	10		
Omao	67	1(b)	X
Oriole, Altamira	36	2	
Oriole, Audubon's	36, 37	2	
Oriole, Baltimore	30		
Oriole, Greater Antillean	69	4(b)	
Oriole, Hooded	35, 36, 37	2	
Oriole, Orchard	20, 22, 25, 26, 27		
Owl, Burrowing	9, 11, 16, 17, 18, 27, 31, 32, 33, 35, 36	1, 2, 4, 6	X

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Owl, Elf	20, 33, 34, 35, 36	2	
Owl, Flammulated	5, 9, 10, 15, 16, 32, 34,35	1(a), 2, 6	X
Owl, Long-eared	23		
Owl, Northern Saw-whet	28		
Owl, Short-eared	11, 16, 17, 22, 23, 24, 25, 26, 28, 30, 37, 67, 69	3, 4(a), 5, 6	X
Owl, Spotted	15, 32		
Oystercatcher, American	27, 30, 31, 37, 69	2, 4(a,b), 5	X
Oystercatcher, Black	1, 5, 32	1(a), 7	X
Parula, Northern	26, 27		
Parula, Tropical	36, 37	2	
Pelican, American White	26		
Petrel, Black-capped	27, 31	4(a)	X
Petrel, Herald	68		
Petrel, Phoenix	68	1(c)	X
Petrel, Tahiti	68	1(c)	
Pewee, Greater	34	2	
Pewee, Lesser Antillean	69	4(b)	
Phalarope, Wilson's	9, 10, 11, 12, 16, 17, 19, 22, 23	3, 6	X
Pigeon, Red-billed	36	2	
Pigeon, White-crowned	31, 69	4(a,b)	
Pintail, White-cheeked	69	4(b)	
Pipit, Sprague's	11, 16, 17, 18, 19, 20, 21, 25, 34, 35, 36, 37	2, 6	X
Plover, Mountain	10, 16, 17, 18, 19, 20, 32, 33, 34, 35, 36	1(a), 2, 6	X
Plover, Snowy	9, 10, 16, 18, 19, 27, 31, 33, 34, 35, 36, 37, 69	1(a), 2, 4(a,b), 6	X
Plover, Wilson's	27, 30, 31, 37, 69	2, 4(a,b)	X
Prairie-Chicken, Lesser	18, 19	2, 6	X
Pygmy-Owl, Ferruginous	36, 37	2	
Pyrrhuloxia	36		
Quail-Dove, Bridled	69	4(b)	
Quail-Dove, Key West	69	4(b)	
Rail, Black	19, 22, 27, 29, 30, 31, 32, 33, 37, 69	1(a), 2, 3, 4(a,b), 5, 6	X
Rail, Buff-banded	68		
Rail, Yellow	9, 10, 11, 12, 14, 26, 27, 31, 37	1(a), 2, 3, 4(a), 5, 6	X
Razorbill	14, 30	5	X
Sage-Grouse, Greater	9	1	X
Sage-Grouse, Gunnison	16	6	X
Sanderling	9, 10, 11, 17		
Sandpiper, Buff-breasted	3, 11, 12, 13, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 30, 31, 36, 37	2, 3, 4(a), 5, 6, 7	X

Sandpiper, Purple	14, 30	5	
Sandpiper, Rock	1, 2, 4, 5	7	X
Sandpiper, Semipalmated	27, 31, 69	4(b)	
Sandpiper, Solitary	9, 10, 11, 16, 18, 19	6	X
Sandpiper, Stilt	12, 22, 23, 24, 25, 26, 27, 31, 36, 37, 69	2, 3, 4(a,b)	X
Sandpiper, Upland	10, 11, 12, 13, 17, 22, 23, 28, 29, 30	3, 5, 6	X
Sandpiper, White-rumped	11		
Sapsucker, Red-naped	10, 17	1(a), 6	X
Sapsucker, Williamson's	9, 10, 15, 16	1(a), 6	X
Sapsucker, Yellow-bellied	28		
Screech-Owl, Whiskered	34	2	
Scrub-Jay, Island	32		X
Shearwater, Audubon's	27, 31, 69	4(a,b)	
Shearwater, Christmas	67, 68		
Shrike, Loggerhead	9, 10, 11, 20, 21, 22, 23, 31, 32, 33, 35, 36, 37	1(a), 2, 3, 5, 6	X
Shrikebill, Fiji	68	1(c)	
Skimmer, Black	27, 30, 31, 32, 33, 37	1(a), 2, 4(a), 5	X
Sparrow, Bachman's	22, 24, 25, 27, 28, 29, 31	2, 3, 4(a)	X
Sparrow, Baird's	11, 17, 34, 35	2, 6	X
Sparrow, Black-chinned	32, 33, 34, 35	2	X
Sparrow, Botteri's	34, 37	2	
Sparrow, Brewer's	9, 10, 17	1(a), 6	X
Sparrow, Cassin's	18, 19, 20, 35, 36	2, 6	X
Sparrow, Field	20, 21, 22		
Sparrow, Grasshopper	11, 17, 22, 34, 37, 69	4(b), 6	X
Sparrow, Harris's	19, 20, 21, 25, 36	2	X
Sparrow, Henslow's	11, 12, 13, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 37	2, 3, 4(a), 5, 6	X
Sparrow, Le Conte's	11, 12, 17, 19, 20, 21, 22, 24, 25, 26, 27, 37	2, 3, 4(a), 6	X
Sparrow, Nelson's Sharp-tailed	11, 14, 27, 31, 37	2, 3, 4(a), 5, 6	X
Sparrow, Rufous-crowned	20		
Sparrow, Rufous-winged	33, 34	2	X
Sparrow, Sage	9, 16, 33, 34, 35	2	
Sparrow, Saltmarsh Sharp-tailed	27, 30, 31	4(a), 5	X
Sparrow, Seaside	27, 30, 31, 37	2, 4(a), 5	X
Sparrow, Song	32		
Sparrow, Vesper	5		
Starling, Samoan	68		
Storm-Petrel, Ashy	32	1(a)	X
Storm-Petrel, Band-rumped	67	1(b)	X
Storm-Petrel, Polynesian	68	1(c)	
Storm-Petrel, Tristram's	67	1(b)	

Surfbird	2, 4, 5	7	X
Swamphen, Purple	68		
Swift, Black	5, 9, 10, 15, 16, 32, 69	1(a), 4b, 7	X
Swiftlet, White-rumped	68		
Tern, Aleutian	1, 2, 5	7	X
Tern, Arctic	1, 2, 5	7	
Tern, Black	12, 23, 27, 31, 37	3	
Tern, Caspian	5		
Tern, Common	12, 13, 14, 22, 23, 27, 30, 31	3, 5	X
Tern, Elegant	32	1(a)	
Tern, Gull-billed	27, 31, 32, 33, 36, 37	1, 2, 4(a)	X
Tern, Least	27, 30, 31, 37, 69	2, 4(a,b), 5	X
Thrasher, Bendire's	16, 33, 34, 35	2	X
Thrasher, Crissal	16, 33, 34, 35	1(a), 2	X
Thrasher, Curve-billed	36		
Thrasher, Le Conte's	32, 33	1(a), 2	X
Thrush, Bicknell's	14, 69	4(b), 5	X
Thrush, Wood	12, 14, 22, 23, 24, 25, 26, 27, 28, 29, 30	3, 4(a), 5	X
Towhee, Spotted	32		
Trogon, Elegant	34	2	
Tropicbird, Red-billed	69	4(b)	
Tropicbird, White-tailed	69	4(b)	
Turnstone, Black	2, 5, 32	1(a), 7	X
Verdin	36		
Vireo, Bell's	18, 19, 20, 21, 22, 23, 24, 25, 26, 33, 34, 35, 36, 37	2, 3, 4(a), 6	X
Vireo, Black-whiskered	31	4(a)	
Vireo, Gray	9, 16, 20, 33, 34, 35	1(a), 2, 6	X
Vireo, Puerto Rican	69	4(b)	
Warbler, Adelaide's	69	4(b)	
Warbler, Arctic	2, 3, 4	7	
Warbler, Bay-breasted	14	5	
Warbler, Blackpoll	2, 14	7	
Warbler, Black-throated Blue	12, 69	3, 4(b)	
Warbler, Black-throated Gray	16, 34	2	
Warbler, Black-throated Green	27		
Warbler, Blue-winged	22, 23, 24, 30	3	
Warbler, Canada	12, 13, 14, 30	3, 5	X
Warbler, Cape May	12, 14	3	
Warbler, Cerulean	12, 13, 22, 23, 24, 25, 26, 27, 28, 29, 30	2, 3, 4(a), 5	X
Warbler, Chestnut-sided	14		
Warbler, Colima	35	2	
Warbler, Connecticut	12	3	
Warbler, Elfin-woods	69	4(b)	X

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Warbler, Golden-winged	12, 13, 23, 28, 30	3, 4(a), 5	X
Warbler, Grace's	16, 34, 35	2	X
Warbler, Kentucky	20, 21, 22, 23, 25, 28, 29, 30, 37	2, 3, 5	X
Warbler, Olive	34	2	
Warbler, Prairie	24, 25, 27, 28, 29, 30, 31, 69	2, 3, 4(a,b), 5	X
Warbler, Prothonotary	20, 21, 22, 25, 26, 28, 29, 37	2, 4(a)	X
Warbler, Red-faced	34, 35	2	
Warbler, Swainson's	21, 24, 25, 26, 27, 28, 29, 37	2, 3, 4(a), 5	X
Warbler, Virginia's	9, 10, 16	6	
Warbler, Worm-eating	21, 22, 24, 25, 28, 30, 69	2, 3, 4(a,b), 5	X
Warbler, Yellow	31, 33, 69	4(b)	
Warbler, Yellow-throated	31		
Waterthrush, Louisiana	22, 24, 25, 28, 69	2, 3, 4(b)	X
Waterthrush, Northern	69	4(b)	
Whimbrel	2, 3, 4, 5, 9, 10, 12, 13, 14, 27, 30, 31, 32, 33, 37	1(a), 3, 4(a), 5, 7	X
Whip-poor-will	13, 22, 24, 28, 29, 30	5	X
Whistling-Duck, West Indian	69	4(b)	
White-eye, Bridled	68	1(c)	X
White-eye, Golden	68	1(c)	
Willet	11		
Woodpecker, Arizona	34	2	
Woodpecker, Gila	33		
Woodpecker, Ladder-backed	20		
Woodpecker, Lewis's	5, 9, 10, 15, 16, 17, 18, 32, 34	1(a), 2, 6	X
Woodpecker, Red-headed	11, 13, 19, 21, 22, 23, 24, 25, 26, 28, 30, 31, 37	2, 3, 4(a), 5, 6	X
Woodpecker, White-headed	5, 9, 10, 15, 32	1(a), 6	X
Wren, Bewick's	22, 24, 25, 27, 28, 29, 37	3, 4(a), 5, 6	X
Wren, Cactus	32, 36		
Wren, Marsh	30		
Wren, Sedge	13, 23, 26, 28, 30, 37	2, 5	X
Yellowlegs, Greater	22, 23		
Yellowthroat, Common	32		

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FWS Comments on 9/20/02 Draft of Chapter IV (Alternatives)

The Fish and Wildlife Service has reviewed the September 20 draft of Chapter IV for the MTM/VF EIS. We previously proposed a four-alternative scenario that included consideration (not selection) of at least one alternative to restrict, or otherwise constrain, most valley fills to ephemeral stream reaches by employing the significant degradation or advance identification (ADID) provisions of the 404(b)(1) Guidelines. Our intent was to provide for consideration of at least one alternative that "developed agency policies, guidance, and coordinated decision-making processes" and minimized the impacts of mountaintop mining and valley filling on waters of the U.S. and fish and wildlife resources; a two-part goal established by the settlement agreement that we believe the three-alternative approach failed to accomplish. Our proposed approach was subsequently voted down within the Executive Committee in part because a decision appears to have been made that even relatively minor modifications of current regulatory practices are now considered to be outside the scope of the EIS process. The current three-alternative framework was adopted, but incorporated only a very limited ADID concept that does not meet our objectives. The September 20 draft retains the deficiencies contained in the previous three-alternative framework, and the full draft of Chapter IV confirms our concerns. Therefore, we continue to object to the use of this approach. However, since the agencies are proceeding based on adoption of this approach, we do not believe that elevating this issue for higher level review would be helpful or productive. The following general comments are intended to provide you only with our sense of how problematic the proposed alternatives framework has become.

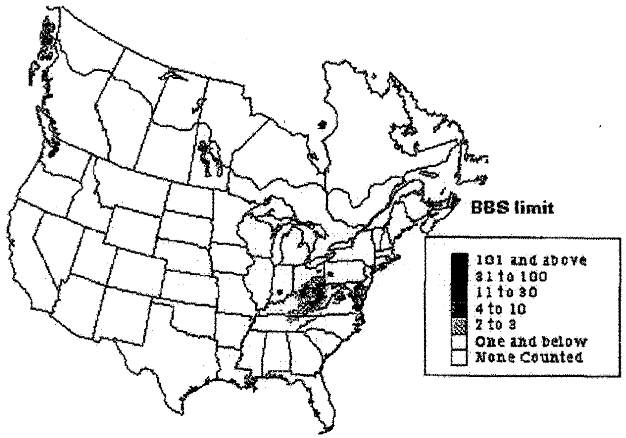
Now that the basic concept has been more fully elaborated in the September 20 write-up, it is painfully obvious to us that there are no differences between the three action alternatives that can be analyzed in a NEPA context. Table IV-2 (Comparison of Alternatives) underscores this fundamental shortcoming: Each of the three action alternatives offers only meager environmental benefits (thus a "two-star rating," as with a budget hotel or B movie), and there is no difference between them -- even in their degree of meagerness. The relative economic effects of these alternatives are similarly indistinguishable. The reader is left wondering what genuine actions, if any, the agencies are actually proposing.

Table IV-1 states that the alternatives would "*minimize*" the adverse effects of mountaintop mining and valley fill construction; the "analysis of alternatives" section states that "all three alternatives will result in greater environmental protection that will fulfill the agencies EIS objectives." As we have stated repeatedly, it is the Service's position that the three "action" alternatives, as currently written, cannot be interpreted as ensuring any improved environmental protection, as stipulated in the settlement agreement, let alone protection that can be quantified or even estimated in advance for purposes of a NEPA analysis. Without providing clear indications of how the Corps would evaluate projects and reach decisions through either the nationwide permit or individual permit processes, and how the SMCRA agency would make its decisions under Alternative 3, the public will not be able to deduce whether impacts to waters under any of these alternatives would be any different than the no action alternative. Furthermore, the results of implementing individual action items whose "actions" do not produce an outcome ("will continue to evaluate," "will work with the states to establish," "will continue to assess," "will continue to refine"), and of developing "Best Management Practices" whose use will be voluntary, are not likely to effect quantifiable, or even recognizable, improvements in environmental protection.

As we have already discussed *ad nauseum*, NEPA regulations describe the Alternatives section as "the heart of the environmental impact statement" which, in combination with the Affected Environment and Environmental Consequences sections, should "present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public." Even after considering the necessarily broad, programmatic nature of this document, we have clearly failed to meet these standards.

The EIS technical studies carried out by the agencies -- at considerable taxpayer expense -- have documented adverse impacts to aquatic and terrestrial ecosystems, yet the proposed alternatives presented offer no substantive means of addressing these impacts. The alternatives and actions, as currently written, belie four years of work and the accumulated evidence of environmental harm, and would substitute permit process tinkering for meaningful and measurable change. Publication of a draft EIS with this approach, especially when the public has seen earlier drafts, will further damage the credibility of the agencies involved.

Figure 1. Cerulean Warbler *(Dendroica cerulea)* Summer Distribution Map. The North American Breeding Bird Survey Results and Analysis, Relative Abundance Map 1966 – 2002. USGS 2003.



These maps indicate the number of birds seen on BBS routes, grouped into convenient categories of relative abundance. The maps predict the average number of birds of the species that could be seen in about 2.5 hours of birdwatching along roadsides (by very good birders). They are based on mean counts on BBS routes over the interval 1982 – 1996.

CERULEAN WARBLER (*DENDROICA CERULEA*) MICROHABITAT AND LANDSCAPE-LEVEL HABITAT CHARACTERISTICS IN SOUTHERN WEST VIRGINIA IN RELATION TO MOUNTAINTOP MINING/VALLEY FILLS

Final Project Report

December 2002

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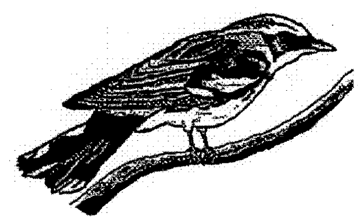

Cerulean Warbler (*Dendroica cerulea*) Microhabitat and Landscape-Level Habitat Characteristics in Southern West Virginia in Relation to Mountaintop Mining/Valley Fills

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Abstract

The Cerulean Warbler (*Dendroica cerulea*) is a species of conservation concern in eastern North America, where declines in its population have been documented over the last several decades. Both habitat fragmentation and increased edge may negatively impact Cerulean Warbler populations. A high proportion of this species' population occurs in forested areas of southern West Virginia, where it may be threatened by loss and degradation of forested habitat from mountaintop mining/valley fills (MTMVF). We examined the impact of forest fragmentation (in particular the effects of fragment size and response to edges) on Cerulean Warbler densities from a landscape perspective using territory mapping techniques and geographic information system (GIS) technology. Specific objectives were: (1) to quantify Cerulean Warbler territory density and indices of reproductive success in forests fragmented by MTMVF mining and in relatively intact blocks of forest, (2) to quantify landscape characteristics affecting Cerulean Warbler territory density, and (3) to quantify territory-level characteristics of Cerulean Warbler habitat. The study area included portions of 4 counties in southwestern West Virginia. Territory density was determined using spot-mapping procedures, and reproductive success was estimated using the proportion of mated males as an index of reproductive performance. We quantified landscape characteristics (cover types and fragmentation metrics) from digitized aerial photographs using Arcview® with the Patch Analyst® extension and measured microhabitat characteristics on spot-mapping plots.

Territory density of Cerulean Warblers was greater in intact (4.6 terr/10 ha) than fragmented forests (0.7 terr/10 ha), although mating success of males was similar in both (60%). Habitat models that included both landscape and microhabitat variables were the best predictors of territory density. The best model indicated that territory density increased with increasing snag density, percent canopy cover >6-12m and >24m, and distance from mine edge. Models for predicting microhabitat use at the territory level were weak, indicating that microhabitat characteristics of territories were similar to habitat available on spot-mapping plots. The species did not appear to avoid internal edges such as natural canopy gaps and open or partially-open canopy roads. Territory placement on ridges was greater than expected and in bottomlands (ravines) and west-facing slopes less than expected based on availability in both intact and fragmented forest. In fragmented forest, 92% of territories occurred only in fragments with ridgetop habitat remaining. Preference for ridges suggests that MTMVF may have a greater impact on Cerulean Warbler populations than other sources of forest fragmentation since ridges are removed in this mining process. Generally, our data indicate that Cerulean Warblers are negatively affected by mountaintop mining from loss of forested habitat, particularly ridgetops, and from degradation of remaining forests (as evidenced by lower territory density in fragmented forests and lower territory density closer to mine edges).

Introduction

The Cerulean Warbler (*Dendroica cerulea*), a species of concern in the eastern United States, occurs at high densities in southern West Virginia. Cerulean Warblers have been declining in many parts of their range (Sauer et al. 2000), and southwestern West Virginia may represent a significant source population for this species in the eastern United States (Rosenberg and Wells 2000). A recent status assessment by the U.S. Fish and Wildlife Service indicates that the population is declining at "precipitous rates" and that the primary threat to the species is loss of habitat (Hamel 2000). The assessment also suggests that successful management will depend upon managing high quality habitat in forested landscapes (Hamel 2000). It is estimated that 47% of the Cerulean Warbler population in North America occurs in the Ohio Hills physiographic area (Rosenberg 2000), which includes part of southern West Virginia. Partners in Flight (PIF) identified the Cerulean Warbler as priority species for conservation in the upland forest community of the Ohio Hills and Northern Cumberland Plateau physiographic areas (Rosenberg 2000, C. Hunter, personal communication), the 2 areas within which our study sites fall. This species also is listed as being at Action level II (in need of immediate management or policy range-wide) by PIF (Rosenberg 2000).

A current potential risk to Cerulean Warbler populations is the coal mining technique of mountaintop mining/valley fill (MTMVF). These extensive surface mines can impact areas on the order of 2000 ha in size, converting a landscape that is predominantly forested to a landscape of predominantly early successional habitats with remnant forest fragments (Wood et al. 2001). It is imperative to understand how these landscape-level changes could impact Cerulean Warblers, a species that inhabits large tracts of mature deciduous forest with large, tall trees (Hamel 2000). The species appears to use edges of small canopy gaps within large tracts; however, the use of openings and edges needs further study. Other high priority research needs include occurrence and density of this species relative to landscape characteristics, especially in relation to forest fragmentation, habitat preferences in relation to vegetation structure, and response of populations to land management activities (Hamel 2000).

Fragmentation and loss of forest habitat from a variety of human-induced disturbances are major issues in wildlife conservation due to negative effects on a number of wildlife species, including Cerulean Warblers. Because West Virginia is predominantly forested, it provides important habitat for forest interior songbird species that require large tracts of unbroken forest. Mountaintop mining/valley fill sets back successional stages, essentially converting large areas of mature hardwood forest to early successional habitat. Forested valleys located below the target coal seams and beyond the reach of the valley fills often appear vegetatively similar to nearby contiguous tracts of forest, but are partially surrounded by actively mined or reclaimed areas resulting in large amounts of edge habitat. These edges may attract known nest predators, such as American Crows (*Corvus brachyrhynchos*) and Blue Jays (*Cyanocitta cristata*), and a known nest parasite, the Brown-headed Cowbird (*Molothrus ater*), which may negatively affect songbird populations by reducing productivity (reviews by Yahner 1988, Paton 1994).

The current federal status assessment indicates that "habitat destruction, fragmentation, and modification on breeding and nonbreeding areas" are most likely responsible for the decline of this species (Hamel 2000). The major effect of MTMVF on Cerulean Warblers is the loss and fragmentation of forested habitat. Fragmentation may negatively affect forest-dwelling songbirds because of isolation effects, area effects, edge effects, and competitive species interactions (Finch 1991, Faaborg et al. 1995). In a forested landscape, fragmentation results from timber harvests, roads, powerlines, stand diversity, and natural canopy gaps. This is a much finer scale than occurs in agricultural areas, where forests appear as islands in a sea of crops and/or pastureland. Fragmentation in a forested landscape might be viewed as "internal" or soft fragmentation, whereas fragmentation in an agricultural landscape might be viewed as "external" or hard fragmentation (Hunter 1990). Fragmentation in an agricultural landscape is often permanent, but fragmentation in forested landscapes is usually temporary (Faaborg et al. 1995). Faaborg et al. (1995) suggested that the latter type of fragmentation is less severe to forest birds than permanent fragmentation, but nonetheless, "detrimental effects still exist." For example, Duguay et al. (2001) found that the number of Wood Thrush fledglings produced in clearcuts was less than in unharvested forest, but the number produced was still high enough to prevent the clearcuts from being sink habitat. Weakland et al. (2002) found that the abundance of some forest interior species declined after diameter-limit harvesting, but the abundance of most species was not affected when a large diameter-limit (>45cm) was used. There are no published studies documenting the effect of MTMVF on forest-dwelling songbirds as forests are lost and fragmented due to mining activities. Thus, it is unclear whether or not MTMVF acts as an internal or external fragmentation event to songbird species. The severity of the habitat loss/fragmentation will depend on whether MTMVF areas are re-forested or if they are allowed to remain in early stages of succession. Even when natural succession occurs on reclaimed MTMVF sites, it can be very slow due to soil compaction

and lack of a seed bank. Non-timber post-mining land uses such as grazing or development will result in permanent fragmentation of forest habitats.

During 1999 and 2000, we quantified the effects of MTMVF on songbird populations (Wood et al. 2001). Using point count methodology, we found Cerulean Warblers at relatively high abundances in both intact (47 point count stations) and fragmented forest (36 point count stations). They were detected at 62% of intact forest point counts and at 44% of fragmented forest point counts. However, the number of fragmented forests that we were able to sample (8) was relatively low, and we did not sample a large range of different-sized fragments. Additionally, presence of an individual does not imply that it bred there (Van Horne 1983).

In 2001 and 2002, we re-sampled our existing study sites and quantified Cerulean Warbler density using territory mapping techniques. Territory mapping can be a more accurate and precise method of estimating bird abundance (Bibby et al. 1992) and allowed us to make inferences concerning the relationships between bird density and habitat and landscape variables. We also added study sites in additional forest fragments resulting from MTMVF to assess the effects of fragment size and edge type. We measured microhabitat characteristics in the field and landscape characteristics from aerial photographs and related these to Cerulean Warbler territory density. Our specific objectives were: (1) to compare Cerulean Warbler territory density and an index of reproductive success in forests fragmented by MTMVF mining with those in relatively intact blocks of forest in southern West Virginia, (2) to quantify landscape characteristics affecting Cerulean Warbler territory density, and (3) to quantify territory-level characteristics of Cerulean Warbler habitat.

METHODS

Study Sites

Our study sites were located in mature forest surrounding three mountaintop mine/valley fill complexes within three watersheds in Boone, Logan, Kanawha, and Fayette counties, West Virginia (Figs. 1-4). One mine complex (2003 ha) in Kanawha and Fayette counties was in the Ohio Hills physiographic province; the other two (1672 and 1819 ha) were in the Northern Cumberland Plateau. These sites were used in our previous study of the impact of MTMVF on terrestrial wildlife in 1999 and 2000 (Wood et al. 2001).

Intact forest sites were relatively large, unfragmented areas of forest that were undisturbed by mining activities but located near reclaimed MTMVF complexes, either within the same watershed as the reclaimed site or in an adjacent watershed. Although these sites were relatively contiguous forest, they did have some breaks in canopy cover from streams, roads, powerlines, and natural canopy gaps. Some intact forest sites were located in close proximity to MTMVF areas, but no intact forest site shared more than one edge with an MTMVF area. We defined fragmented forest as a tract of forest located within a MTMVF complex and primarily surrounded by reclaimed mine land. Because these tracts are often long, narrow peninsulas of forest, they generally are surrounded by reclaimed land on at least three sides.

The intact and fragmented forest areas are comprised mostly of mature hardwood species including oaks (*Quercus* spp.), hickories (*Carya* spp.), tuliptree (*Liriodendron tulipifera*), American beech (*Fagus grandifolia*), red maple (*Acer rubrum*), sugar maple (*A. saccharum*), and white ash (*Fraxinus americana*). These stands are second growth forests that appeared to be approximately 60-80 years old. Although forested, these stands may have been periodically disturbed over the last several decades from firewood cutting, single tree harvesting, thinning, and understory forest fires.

Surveys/sampling

In 2001, we established six intact forest plots (two within each watershed) and 19 plots in 15 fragments. Two additional intact plots were added to the study in 2002.

We surveyed Cerulean Warblers using a territory-mapping technique called spot-mapping (Bibby et. al 1992). Plots were placed near the center of 15 forest fragments ranging from 1-290 ha, allowing us to examine territory density relative to fragment size. In 2 larger fragments, two 10 ha plots were established, 1 near the center and 1 adjacent to a reclaimed grassland mine edge to examine response to major edge type (Table 1). In the largest fragment, 3 plots were established, 1 adjacent to edge (10 ha), 1 interior on a mid-slope (7.5 ha), and 1 along a stream (10 ha). In fragments <10 ha in size, the whole fragment was surveyed for Cerulean Warblers; therefore plot size was equal to fragment size (Table 1). All intact forest plots were 10 ha in size. Although intact forest plots were at least 100 m from the mine edge, they still contained internal edges due to the presence of roads, streams, and natural canopy gaps, giving us the opportunity to assess the effects of these edge types on Cerulean Warbler densities.

Each fragmented forest and intact forest plot was surveyed at least 10 times from the first week of May to the first week of July each year (Bibby et al. 1992). Surveys were conducted from one-half hour after sunrise to 1030 hr EST. All surveys were conducted by 3-5 observers experienced in songbird identification and trained in territory-mapping procedures. The maximum number of territories/10 ha on each plot between years was used in statistical analyses.

Assessing Reproductive Success

Information on Cerulean Warbler reproductive success is greatly needed, but it was logistically unfeasible to find enough nests of this canopy-nesting species to have an adequate sample size needed to determine survival rates. Therefore to evaluate reproductive performance, we opportunistically gathered evidence of breeding, such as nest location and nestling food provisioning, and male/female interactions on each plot by observing Cerulean Warbler activity during territory mapping. Although these methods are limited, we believe they provided us with at least some information on the reproductive success of Cerulean Warblers within our study area. Vickery et al (1992) applied a similar method while studying sparrow species in Maine, for which they could find few nests. Researchers studying the Kirtland's Warbler (*D. kirtlandii*) (Probst and Hayes 1987), Ovenbirds (*Seiurus aurocapillus*), and Kentucky Warblers (*Oporornis formosus*) (Gibbs and Faaborg 1990) also used similar methods to estimate pairing success.

Microhabitat Sampling

We quantified microhabitat characteristics within each plot using modified methods from BBIRD (Martin et. al 1997) and James and Shugart (1970). We established two 0.04-ha quadrats per hectare in each territory-mapping plot. Quadrats were systematically distributed approximately every 50 m throughout the plot (Ratti and Garton 1994), except at sites that were used in our previous study in 1999-2000. We used existing microhabitat information from these sites (sampling methods were the same in both studies and habitat conditions had not changed) and only collected additional microhabitat measurements if the sample size was <2 quadrats/ha. One 0.04-ha quadrat was established at the center of each territory. Measurements included tree densities and diameters, density of snags >8 cm dbh (diameter-at-breast height), canopy height, aspect, percent slope, and percent canopy cover and ground cover as measured using an ocular tube (James and Shugart 1970). Snags were defined as standing dead trees >8 cm in diameter with no live foliage present.

We also determined the distance from the center of the territory to the closest edges using aerial photographs, compass, and pacing. Internal edge types included the following: open-canopy road, partially-open canopy road (including skidder trails), development (i.e. houses, buildings, etc.), river or stream, and natural canopy gap. Open-canopy roads were those that were not overtopped by trees and from which open sky was observed. Partially-open canopy roads were overtopped by trees and revealed little open sky. Natural canopy gaps were openings created by snags and/or windfalls. Mine edge was considered an external edge and was measured at the territory-level only when mine was the closest edge type. The mean of quadrat measurements for each variable for each plot was used in statistical analyses. Microhabitat measurements also were made at Cerulean Warbler nests using the methods described above.

Landscape Analyses

We quantified landscape characteristics by digitizing georeferenced copies of the 1996-97 National Aerial Photography Program (NAPP) photographs for our study areas into 7 land use/land cover categories: mature deciduous forest, mature mixed coniferous/deciduous forest, grassland, barren, shrub/pole, water/wetlands, and developed. Roads, trails, and streams were overlaid on cover maps to examine territory placement relative to these canopy gaps. Fragment size was measured from aerial photographs. Final maps were corrected to reflect changes since 1996. We used these maps to calculate the amount of each cover type within 1 km of the center of each study plot and to calculate fragmentation indices that may predict the density of Cerulean Warblers. Fragmentation indices included contrast-weighted edge density (Appendix 1), core area of mature forest, area of fragment or continuous forest (within 2-km of the plot center), and distance from mine edge. We used a 100-m buffer to calculate core area and edge density. Arcview® (Environmental Systems Research Institute 1996) with the Patch Analyst© extension (McGarigal and Marks 1994, Elkie et al. 1999) was used for all landscape analyses.

Statistical Analyses

Habitat models

To develop habitat models, we followed the recommendations of Burnham and Anderson (1998) who advocate an information-theoretic approach, which is based the principle of parsimony. This principle implies that a model should be as simple as possible with respect to the included variables, the model structure, and the number of parameters. They recommend the use of Kullback-Leibler information and Aikaike's information criterion (AIC) as the basis for modeling rather than null hypothesis testing. With this approach, one selects a set of candidate models prior to examining the empirical data. The *a priori* models are selected based on previous knowledge of the species in question. Variables are dropped or combined before modeling with the actual data. When little is known about the system in question, a large number of candidate models may be examined in an exploratory analysis. As Burnham and Anderson state, this method emphasizes thinking about the set of candidate models, excluding those variables that probably are not relevant to the species, and looking for potentially important variables in the literature. Models are evaluated by comparing relative AIC values among models and by examining Aikaike weights to

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determine the probability of each model being selected for the given data relative to all the others (Burnham and Anderson 1998).

Habitat available for Cerulean Warblers was evaluated 3 ways: at the microhabitat level (plot), landscape level, and the territory level. We began model selection at the microhabitat and landscape levels by first examining the frequency distribution of Cerulean Warbler territories, which was found to be a Poisson distribution (Neter et. al 1988). We then modeled the relationship between territories and habitat variables using Poisson regression (Stokes et al. 1995).

Microhabitat variables included in the candidate models were density of large trees (>38 cm dbh) and snags, distance from the closest edge, and canopy cover in 4 height classes (Table 2). We excluded understory stem densities, ground cover, and low canopy cover (<6 m) which likely have little influence on habitat selection by this canopy-dwelling species. Average canopy height also was excluded. Since Ceruleans are known to select the tallest trees as singing perches, we felt that including this variable would bias the results.

At the landscape level, variables were combined or excluded based on known preferences of the species or because they were highly correlated to one another. The area of mature deciduous forest was removed from the analysis because it was highly correlated to core area of mature forest. Cover of shrub/pole, grassland, wetlands/ponds, and barren were combined into one cover class (mine) to help reduce the overall number of variables in the model because the species is not likely to select any of these habitats. Landscape variables included in the candidate models were mine cover, mature mixed conifer/deciduous cover, development cover, as well as 4 fragmentation indices (Table 2).

Because little is known about Cerulean Warbler habitat use in West Virginia and there is no information regarding landscape effects from mountaintop removal on this species, we proceeded with an exploratory analysis and examined a large number of candidate models (n=488) using a top-down approach by starting with the full model and deleting variables (Burnham and Anderson 1998). The full model included all 14 microhabitat and landscape variables (Table 2). We then calculated AIC values with a correction factor (AIC_C), because our sample size to parameter ratio was <40 (Burnham and Anderson 1998). Models examined included all 14 univariate models, microhabitat-only models, landscape-only models, and combined models with both microhabitat and landscape variables.

To examine territory-level habitat use, we developed logistic regression models from use/non-use data with the same variables used in microhabitat analyses. Use data were measurements taken

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at the center of territories (primarily singing male core areas or nest sites). Non-use data were measurements taken on subplots that fell outside the areas used by singing males, as determined from spot-maps (Figs. 5-14). Two sets of logistic regression models were developed. The first used data from all vegetation subplots in all plots. The second used data only from plots where Cerulean Warblers were found, to exclude plots where Ceruleans may not have been detected because of the landscape. We selected the 5 best models from a set of 20 candidate logistic models initially developed from knowledge of Cerulean Warbler habitat preferences from the literature and from consulting with others who study this species. AIC_c values were used to select the 5 best models.

Comparisons between treatments

We used chi-square analysis (Zar 1999) to examine the difference between the used and available habitat in fragmented and intact forest. We then calculated Bonferroni 95% confidence intervals (Neu et al. 1974) for the proportion of occurrence in each habitat category and compared them to the available habitat.

Cerulean Warbler density relative to slope, aspect, and edges

Cerulean Warbler territory placement relative to slope position, aspect, and edges was examined using chi-square analysis (Zar 1999) and Bonferroni 95% confidence intervals (Neu et al. 1974). The occurrence of Cerulean Warbler territories in each category was determined by using the position of the center of the territory. Ninety-five percent confidence intervals were calculated to examine the difference between the proportion of occurrence and the proportion of available habitat in each category.

We measured the area of each spot-mapping plot that was ridge, mid-slope, and low-slope to determine the proportion available for each slope position. The expected number of territories in each category was determined by multiplying the total number of territories by the proportion of available habitat in each category. Ridge was considered the area of the plot at the peak with little or no slope. Low slope was the area of the plot that was at the foot of the slope <25 m from a stream or creek bottom. Mid slope was all the area between the low slope and the ridge. We determined the area of each plot that faced east (0-180°), and west (>180-359°), as well as the area in ridge top and bottomland that have no slope and thus no aspect. Aspects could not be broken down further because of small sample sizes.

We used chi-square (Zar 1999) to compare use and availability of edge types. Edge type use was the closest edge to each territory. We determined the availability of edge types using data from the non-use vegetation quadrats. The proportion of quadrats in each closest edge category was

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considered available edge habitat. The expected total number of territories was the product of the total number of observed territories and the proportion of edge types available in each edge category. We compared the proportion of edge types available between fragmented and intact forests using a paired t-test (Neter et al. 1988).

Mating success

We attempted to observe mating and reproductive behavior on all plots in 2001, and on a sub-sample of plots in 2002. Initially we planned to rank male reproductive success using the reproductive index score of Vickery et al. (1992). However, because these birds stay relatively high in the canopy, females are notoriously secretive, and few active nests were found, the reproductive index score was not effective for use with our data. However, we present findings for all males that were followed and observed for at least 60 min. Males were considered mated if a female was observed on the territory, the male was observed feeding fledglings, or the male sang the "whisper" song, which is only sung by mated males (J. Barg, pers. comm.). Males were considered unmated if they never sang the whisper song, females were never observed on the territory, fledglings were not observed, and the male had a high rate of singing.

RESULTS

Treatment Comparisons

We mapped 14 territories on 175.3 ha of fragmented forest in 2001 and 10 in 2002 (Figs. 5-11) for an average territory density of 0.7 territories/10 ha. In intact forest, we mapped 24 territories on 60 ha in 2001 and 40 on 80 ha in 2002 (Figs. 12-14) yielding a mean territory density of 4.6 territories/10 ha. The proportion of observed territories was less in fragmented forest and greater in intact forest than the proportion expected based on the habitat available in each treatment (Table 3, Fig. 15). Seventy-three percent of all territories were in intact forest, although only 28.5% of the total area surveyed was intact forest. Territory density was over 6 times higher in intact than fragmented forest.

Microhabitat and Landscape Models

The 5 best habitat models were combined models that included both microhabitat and landscape variables (Table 4). All 5 models included 3 microhabitat variables (percent canopy cover >6-12 m (Fig. 16), percent canopy cover >24 m (Fig. 17), and snag density (Fig. 18)) and the landscape variable distance from mine edge (Fig. 19) as predictor variables. All variables were positively related to Cerulean Warbler territory density. The best model had an Aikaike weight of

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0.58 relative to the other 487 models, indicating that it had a 58% probability of being chosen given the data. The next best model had a much lower weight, of 0.09. Although distance from mine edge appeared to have a weak relationship with density when all distances were examined, a closer inspection of the data showed a strong relationship up to 500m from the mine (Fig. 19).

The best microhabitat model contained snag density, percent canopy cover >6-12 m, and percent canopy cover >24 m as predictor variables, but had a low weight (w <0.01) compared to the combined models. The best landscape model contained area of mature mixed conifer/deciduous forest and core area of mature forest (Fig. 20) as predictors but also had a very low weight (w <0.01). Area of fragment/continuous forest also was one of the better predictors (Fig. 21).

Territory-level Models

To identify microhabitat characteristics that Cerulean Warblers may use for placement of their territories within a plot, we developed logistic regression models comparing territory and available sites. The 5 best models developed from all plots and only from plots with Cerulean Warbler territories all had low Aikaike weights (Table 5) indicating that these variables are poor predictors of Cerulean Warbler territory placement. Means and standard errors for these variables indicate only a small difference between non-use subplots and territory subplots (Appendix 2), which may not be biologically significant.

Density relative to aspect, slope position, and edges

For all plots combined, ridge habitat use by Cerulean Warblers was greater than availability whereas mid slope habitat use was less than availability (Table 3, Fig. 22). The proportion of occurrence on low slopes did not differ from what was available. This trend was the same in both fragmented and intact forests (Table 3). Territory density was over twice as high on ridges than on low and mid slopes (Table 3).

The proportion of Cerulean Warbler occurrence was less than the proportion available on west-facing slopes and bottomlands and greater than what was available on ridges; it did not differ from what was available on east-facing slopes (Table 3). Again, this trend was similar between intact and fragmented forests. Density was twice as high on ridges than east-facing slopes and 4 times greater on ridges than west-facing slopes and bottomlands (Table 3).

When territories in fragmented and intact forest were combined, territory placement in relation to closest edge type was different from expected (?2=36.82, df=4, P<0.001) based on edges available on the territory-mapping plots (Table 6). Territories were adjacent to streams less than expected and adjacent to partially-open canopy roads greater than expected (Table 6). The

distribution of closest edge types did not differ between fragmented and intact forest (t<0.01, df=4, P=1.00) (Fig. 23), so a similar pattern of selection was observed in each treatment. In both treatments, territories were adjacent to streams less than expected and adjacent to partially-open and open canopy roads greater than or equal to expected.

Most territories (63%) crossed either an open or partially-open canopy road/trail (Figs. 5-14). The mean distance to the closest internal edge was 30.3 m from a territory center and 34.4 m from a non-use subplot (Table 7). Both the logistic and the Poisson regression models showed a negative relationship between Cerulean Warbler territory presence/density and distance from closest edge indicating that they preferred areas closer to internal edges. Two territories in very small fragments were not included in analyses of closest internal edge because their closest edge was an external (mine) edge.

Mating Success

We were able to follow 10 males in fragmented forest (on 6 plots) and 30 males in intact forest (on 6 plots) in the 2 years of the study to determine mate status. Of the 10 males that were followed in fragmented forest, 60% were confirmed mated based on the presence of a female on the territory or observations of the male feeding fledglings, whereas 40% were assumed unmated, based on singing behavior and no observed female on the territory. Similarly, in intact forest, 60% of the 30 males observed were assumed to be mated based on observations of females with the male (30%) or because of "whisper singing" behavior (30%). Forty percent were assumed to be unmated. Males were observed feeding fledglings on 2 fragmented forest plots and 1 intact forest plot. One of these males was in one of the smaller fragments (9.4 ha), that had a considerable amount of edge habitat.

Four nests were found, 1 in 2001 and 3 in 2002. Three nests were in intact forest and 1 was in fragmented forest. One nest was successful, 2 were unsuccessful (possibly due to abandonment after severe weather), and 1 fate was unknown. Habitat characteristics around nest sites are summarized in Table 8. Nest tree species were northern red oak (*Quercus rubra*), tuliptree (*Liriodendron tulipifera*), american basswood (*Tilia americana*), and bitternut hickory (*Carya cordiformes*).

DISCUSSION

Our data indicate that loss and fragmentation of forests by MTMVF mining in southern West Virginia is negatively affecting populations of Cerulean Warblers. Cerulean Warbler territory density was lower in forests fragmented by mining than in intact forests. Both microhabitat and landscape components are important factors influencing territory densities.

Consistent predictors of territory density at the microhabitat level were percent canopy cover >6-12 m, >24 m, and snag density. Previous research indicates that Cerulean Warblers prefer a canopy divided into distinct vertical layers in flood plain forests of North Carolina, where tall, old-growth trees dominate the canopy (Lynch 1981). This bird typically nests at heights between 4.6-18.3 m (summarized in Hamel 2000), and thus it is not surprising that Cerulean Warbler territory density was higher in stands with a high amount of canopy cover from >6-12 m. Preference for areas with canopy cover >24 m is in agreement with studies that found this species in areas with large, tall trees and a dense upper canopy (Lynch 1981, Robbins et al. 1992, Oliarnyk 1996). Additionally, Hamel (2000) suggests that the vertical distribution of foliage may be more important than individual values of canopy cover at different heights. Thus, it is not surprising that canopy covers at 2 height classes were identified as predictors of Cerulean Warbler density.

The preference for a high density of snags is likely related to the apparent preference for areas with gaps in the canopy as noted by other researchers (Oliarnyk 1996, Oliarnyk and Robertson 1996). Snags likely contribute to the complex canopy structure apparently preferred by Ceruleans by opening the canopy allowing development of understory trees and by increasing heterogeneity of the canopy. Further, our data indicate that Cerulean Warblers in our study area are not avoiding internal edges. We often observed both males and females in or near canopy gaps, such as open and partially-open trails and roads and natural tree fall gaps. Two of the 4 nests we observed were within 10 m of a canopy gap (a natural tree fall gap and a partially-open canopy road).

Landscape factors also were significant predictors of Cerulean Warbler territory density. Distance from mine was positively related to density, particularly within 500 m (Fig. 19), indicating that Ceruleans are avoiding the large-scale edges produced by the mines. Cerulean density also was positively associated with core area of mature forest (Fig. 20) and area of fragment (Fig. 21), indicating a preference for large-blocks of mature forest similar to findings of Robbins et al. (1989) and Robbins et al. (1992). Density was negatively associated with area of mixed conifer/deciduous forest, which is primarily composed of Eastern hemlock. (*Tsuga canadensis*) on our study sites. This result also is not surprising given that this species is known to be restricted to mature deciduous forests (Hamel 2000).

Results at the territory level were inconclusive. Our data indicate that there was little difference in microhabitat between territories and non-use areas. It is possible that Cerulean

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Warbler habitat is not limited within the mixed mesophytic forests of southwestern West Virginia and that suitable areas are not being occupied. Males may settle where others are already present and form loose "colonies" (Hamel 2000). If this is true, then Cerulean Warblers would exhibit a clumped distribution across the landscape, and it would appear that suitable habitat is not being used. Our data suggest that Cerulean Warblers may follow this pattern (Fig. 5-14). Single males occurred on only 3 plots where Cerulean Warblers were present.

Other studies identified large-diameter trees as being important for Cerulean Warblers (Robbins et al. 1992, Oliarnyk 1996, Hamel et al. 1994). We did not find tree diameter to be an important predictor of Cerulean Warbler occurrence. We often observed clusters of territories on ridges with "small" trees relative to tree size in other areas of the forest. Our data suggest that tree size may be less important for Cerulean Warblers in West Virginia than in other areas. Hamel (2000) suggested that tree diameters and heights may not accurately reflect Cerulean Warbler habitat and cannot be extrapolated among areas because these metrics are a function of topography, soils, and the site on which the forest is growing.

Both slope and aspect influenced Cerulean Warbler territory placement in our study. Territories were found more than expected on ridges. Brooks (1908) was the first to note the tendency of Cerulean Warblers to occupy breeding territories at or near the top of hills in West Virginia. Researchers in Indiana also have observed a similar trend in territory distribution (K. Islam, personal communication). Researchers with the Cerulean Warbler Atlas Project (CEWAP) in West Virginia also found Ceruleans to be more prevalent on dry slopes and ridges; approximately 65% of their sightings were in these areas (Rosenberg et. al 2000). Ridgetops may have structural features that attract Cerulean Warblers. Our data indicate that plots with ridgetops may have higher densities of snags (t=-2.57, df=21, P=0.01) than plots without ridges. Thus canopy gaps, which may be important for Ceruleans, likely are more prevalent on plots with ridges. However, neither canopy cover >6-12 m or >24 m differed between plots with ridges and those without ridges. More research is needed to determine the factors on ridges that attract Cerulean Warblers.

The preference for ridges could result in significant impacts on Cerulean Warbler populations in the MTMVF region. Because ridges are removed with this type of mining, Cerulean Warbler preferred habitat is lost. This could be one factor contributing to lower territory densities in forests fragmented by MTMVF mining. The majority of Cerulean Warbler territories in fragmented forest plots were on those that had ridges remaining. Of fragments without ridges, only 2 out of 7 had Cerulean Warbler territories (mean=0.17/10 ha), compared to 6 out of 8 with ridges

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that had Cerulean Warbler territories (mean=0.95/10 ha). On intact plots, those with ridges had a mean territory density of 6.0/10 ha compared to 0.80/10 ha on those without ridges. Analysis of point counts from our earlier study of MTMVF mining also indicates that Cerulean Warblers were found greater than expected at points on ridges (Weakland and Wood, unpub. data). Thus, continued removal of ridges in southern West Virginia by MTMVF mining could have serious negative effects on Cerulean Warbler populations.

The preference for placing territories on ridges also has implications for using BBS data for monitoring populations. Most BBS routes in this part of West Virginia are run primarily along valleys, where territory density is likely lowest; therefore density or abundance estimates based on BBS data are likely underestimates. However, we have found that Cerulean Warbler abundance at off-road point counts in West Virginia generally follows a similar pattern to BBS trends, although abundance estimates cannot be compared directly (Weakland et al. *in review*).

One limitation of our study was lack of information on breeding success. Although we anticipated difficulty in finding nests, we had expected the reproductive index of Vickery et. al (1992) to be more effective. Although we were not able to follow all of the males that we mapped on the plots, our data do provide some insight into reproductive performance. The proportion of mated males is likely to be an underestimate rather than an overestimate, since males we classified as unmated could have had a female that we did not detect. However, based on evidence of nesting and sightings of fledglings, it appears that Cerulean Warblers are breeding in both intact and fragmented forests in southern West Virginia and that the proportion of mated males (60%) is similar.

Researchers from Ontario who mistnetted males on our plots captured 5 males in fragmented forests and 14 in intact forest. In fragmented forests, 40% were second-year (SY; i.e. 1-year-old) males, and in intact forests, 21% were SY birds (K. Girvan, unpub. data). Although the data are limited, they suggest that Cerulean Warblers are breeding successfully in this area, but SY birds may be displaced into fragmented forests, which may be less suitable habitat.

SUMMARY

In conclusion, both landscape and microhabitat factors are influencing Cerulean Warbler density in southern West Virginia. Cerulean Warblers appear to prefer ridgetops within large blocks of mature forest with a high percent canopy cover from >6-12m and >24m, and a high density of snags. They do not appear to be avoiding internal (soft) edges such as roads and trails,

but do appear to be avoiding the external (hard) edges created by mining. Generally, MTMVF mining reduces the amount of forested habitat available for use by Cerulean Warblers and is lowering the suitability of the remaining forest habitat as evidenced by lower territory density in fragmented forest and near mine edges. Because of the large size of most MTMVF areas, it is possible that they may have negative effects on populations of the Cerulean Warbler that require large blocks of unfragmented forest for breeding. Loss of ridgetop habitat appears to be particularly important in reducing territory density. The 3 MTMVF complexes on our study areas totaled 7,244 ha with approximately 76% in grassland habitat, 14% shrub/pole, and 10% fragmented forest (Wood et al. 2001). If we assume that this area was approximately 80% intact forest before mining, take into account that some fragmented forest remained after mining, and use a mean territory density of 4.6 territories/10ha in intact forest and 0.7 territories/10ha in fragmented forest, then potentially 2,625 Cerulean Warbler males could have been displaced by these 3 mines. However, at this point we do not know if nesting success differs between intact and fragmented forests or among different slope positions. So, although territory density may be higher in intact forest and on ridgetops, fledging success may not necessarily be higher than other areas.

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Table 1. Mine sites, treatments, study plots, and size of plots used to map Cerulean Warbler territory densities in southern West Virginia in 2001 and 2002.

Treatment	Mine	Site	# of Plots	Plot sizes (ha)	Forest Size (ha)[a]
Fragmented	Cannelton	Center A	1	8.6	8.6
		Center B	1	9.4	9.4
		Center C	2	10.0	36.0
		Jim Hollow/Hughes Fork	3	7.5, 10.0, 10.0	290.5
	Daltex	Hurricane	1	10.0	48.5
		Beech Creek	1	10.0	15.9
		Jenny	2	10.0	20.5
		Monclo	1	19.7	19.7
		Warehouse #1	1	1.0	1.0
		Warehouse #2	1	2.8	2.8
	Hobet	Lavender Fork	2	10.0,10.0	153.8
		Big Horse Creek	2	10.0,10.0	113.6
		Stanley Fork East	1	11.6	11.6
		Stanley Fork North	1	9.7	9.7
		Stanley Fork West	1	5.0	23.9
		Total	**21**	**175.3**	
Intact	Cannelton	A	1	10.0	1079
		B	1	10.0	752
		C	1	10.0	926
	Daltex	Pigeonroost A	1	10.0	1177
		Pigeonroost B	1	10.0	1211
		Oldhouse Branch	1	10.0	828
	Hobet	Ballard Fork	1	10.0	789
		Spring Branch	1	10.0	930
		Total	**8**	**80.0**	

[a] Forest size for fragments is the actual size of the fragment and for intact forest it is area of continuous forest within 2-km of the plot center.

Table 2. Microhabitat and landscape variables used to model the territory density of Cerulean Warblers in southern West Virginia.

Variables	Code
Microhabitat	
Percent Canopy Cover:	
>6-12 m	CC6-12m
>12-18 m	CC12-18m
>18-24 m	CC18-24m
>24 m	CC24m
Density of trees >38 cm dbh	Trees38cm
Density of snags >8 cm dbh	Snags
Distance to closest edge	DstEdge
Landscape	
Area of:	
Reclaimed mine	Mine
Mature mixed conifer/deciduous	MatMix
Development	Devel
Contrast-weighted edge density	CWED
Core area of mature forest	CoreArea
Area of fragment/continuous forest	ForArea
Distance to mine	DstMine

Table 3. Occurrence and density of Cerulean Warbler territories in fragmented and intact forests, at different slope positions, and aspects in southwestern West Virginia.

Test	Total ha	Prop. of total ha (p_{io})	No. CERW Observed	No. CERW Expected	Prop. of observed in each area (p_i)	95% Confidence Interval for p_i^a Lower	Upper	?²	df	*P*-value	Territorie /10ha
Treatments											
Fragmented	350.6	0.715	24	63	0.273	0.180	0.366	84.98	1	<0.01	0.7
Intact	140	0.285	64	25	0.727	0.634	0.820				4.6
Slope Position											
All Plots											
Low	32.2	0.066	5	6	0.055	-0.002	0.112	37.33	2	<0.001	1.6
Mid	344.4	0.702	39	62	0.440	0.315	0.564				1.1
Ridge	114	0.232	44	20	0.505	0.380	0.631				3.9
Fragmented Forest											
Low	19.2	0.055	1	1	0.040	-0.009	0.089	5.64	2	<0.10	0.5
Mid	252.4	0.720	12	17	0.480	0.355	0.605				0.5
Ridge	79	0.225	11	6	0.440	0.316	0.564				1.4
Intact Forest											
Low	13	0.093	4	6	0.076	0.009	0.142	23.32	2	P<0.001	3.8
Mid	92	0.657	26	58	0.394	0.272	0.516				2.8
Ridge	35	0.250	34	22	0.500	0.375	0.625				9.4
Aspect											
All Plots											
East	198.8	0.405	37	36	0.407	0.278	0.535	48.45	3	P<0.001	1.9
West	145.6	0.297	5	26	0.055	-0.005	0.115				0.3
Ridge	114	0.232	45	20	0.484	0.352	0.614				3.9
Bottom	32.2	0.066	1	6	0.022	-0.016	0.060				0.6

Fragmented Forest											
East	136.8	0.390	12	9	0.480	0.349	0.611	12.29	3	<0.01	0.9
West	115.6	0.330	1	8	0.040	-0.011	0.091				0.1
Ridge	79	0.225	11	6	0.440	0.310	0.570				1.4
Bottom	19.2	0.055	0	1	0.000	0.000	0.000				0.0
Intact Forest											
East	62	0.443	25	28	0.379	0.252	0.506	28.19	3	P<0.001	4.0
West	30	0.214	4	14	0.061	-0.002	0.123				1.3
Ridge	35	0.250	34	16	0.500	0.369	0.631				9.4
Bottom	13	0.093	1	6	0.030	-0.015	0.075				1.5

[a] p_i represents the theoretical proportion of occurrence and is compared to corresponding p_{io} to determine if the hypothesis of proportional use is accepted or rejected (Neu et al. 1974).

Table 4. Independent variables for the 5 best combined, microhabitat, and landscape Poisson regression models used to predict Cerulean Warbler territory density in southern West Virginia, with their AIC_C values, ? AIC_C values, Aikaike weights (w), and rank (out of 488 models). The '+' and '-' signs before each variable indicate the direction of the relationship between the variable and territory density.

Models	AIC_C	?	w	Rank
Combined				
+CC6-12m, +CC24m, +Snags, +DstMine	-38.46	0.00	0.58	1
+CC6-12m, +CC24m, +Snags, +DstMine, -MatMix	-34.64	3.82	0.09	2
+CC6-12m, +CC24m, +Snags, +DstMine, +CoreArea	-34.34	4.12	0.07	3
+CC6-12m, +CC24m, +Snags, +DstMine, +FragArea	-32.89	5.56	0.04	4
+CC6-12m, +CC24m, +Snags. +DstMine. +Devel, -MatMix	-32.75	5.71	0.03	5
Microhabitat				
+CC6-12m, +CC24m, +Snags	-26.31	12.14	<0.01	36
+CC6-12m, +CC24m, +Snags, -DstEdge	-25.34	13.12	<0.01	41
+CC6-12m, +CC24m, +Snags, +Trees38cm	-24.94	13.52	<0.01	46
+CC6-12m, +CC24m, +Snags, +Trees38cm, -DstEdge	-24.16	14.30	<0.01	52
+CC6-12m, +CC24m, +Snags, -CC12-18, +Trees38cm	-24.13	14.33	<0.01	53
Landscape				
-MatMix, +CoreArea	-22.62	15.84	<0.01	59
-MatMix, +CoreArea, +DstMine	-21.75	16.71	<0.01	60
-MatMix, +CoreArea, -Mine	-21.64	16.81	<0.01	62
-MatMix, +CoreArea, -Mine, +Devel	-19.96	18.49	<0.01	80
-MatMix, +FragArea	-19.75	18.71	<0.01	82

Table 5. The 5 best microhabitat logistic regression models used to predict Cerulean Warbler presence in southern West Virginia, with their AIC_C values, ? AIC_C values, and Aikaike weights (w). The '+' and '-' signs before each variable indicate the direction of the relationship between the variable and territory density.

Models	AIC_C	?	w
All plots			
+CC18-24m	467.18	0.00	0.15
+Snags	467.75	0.57	0.11
+CC18-24m, +Snags	467.81	0.63	0.11
-DstEdge	468.35	1.17	0.08
+CC24m	468.48	1.30	0.08
Only plots with Cerulean Warblers			
+CC18-24m	413.99	0.00	0.13
-DstEdge	414.00	0.01	0.13
+Snags	414.09	0.10	0.12
+CC12-18m	414.19	0.19	0.12
+Trees38cm	414.84	0.85	0.08

Table 6. Occurrence of Cerulean Warblers (CERW) adjacent to different closest internal edge types in southwestern West Virginia.

	Availability				Prop. of	95% Confidence Interval for p_i[a]					
Test/Edge types	Number quadrats	Proportion (p_{io})	CERW Expected	CERW Observed	Observed (p_i)	Lower	Upper		$?^2$	df	P-value
All Plots											
Natural gap	33	0.084	7	10	0.120	0.029	0.212	=[b]	36.82	4	<0.001
Stream	138	0.352	29	5	0.060	-0.007	0.127	<			
Partially open road	125	0.319	26	40	0.482	0.341	0.623	>			
Open road	79	0.202	17	27	0.325	0.193	0.457	=			
>2 Types	17	0.043	4	1	0.012	-0.019	0.043	=			
Fragmented forest											
Natural gap	13	0.052	1	1	0.048	-0.072	0.167	=	18.95	4	<0.001
Stream	98	0.390	8	1	0.048	-0.072	0.167	<			
Partially open road	79	0.315	7	16	0.762	0.523	1.000	>			
Open road	49	0.195	4	3	0.143	-0.053	0.339	=			
>2 Types	12	0.048	1	0	0.000	0.000	0.000	<			
Intact forest											
Natural gap	20	0.142	9	9	0.145	0.030	0.260	=	21.50	4	<0.001
Stream	40	0.284	18	4	0.065	-0.016	0.145	<			
Partially open road	46	0.326	20	24	0.387	0.228	0.546	=			
Open road	30	0.213	13	24	0.387	0.228	0.546	>			
>2 Types	5	0.035	2	1	0.016	-0.025	0.057	=			

[a] p_i represents the theoretical proportion of occurrence and is compared to corresponding p_{io} to determine if the hypothesis of proportional use is accepted or rejected (Neu et al. 1974).

[b] Symbols indicate use equals availability (=), use less than availability so avoids (<), and use greater than availability so prefers (>).

Table 7. Mean distance (m) of Cerulean Warbler territory centers (n=83) and non-use subplot centers (n=392) from the closest internal edge in fragmented forests, intact forests, and combined forests in southern West Virginia.

	Fragmented Forest				Intact Forest				Combined			
	Non-use		Territory		Non-use		Territory		Non-use		Territory	
Edge Types	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean	n	Mean
Natural Gap	13	27.3	1	50.0	20	18.5	9	14.3	33	22.0	10	17.9
Stream	98	32.0	1	15.0	40	28.5	4	27.5	138	31.0	5	25.0
Partially-open canopy road	79	20.1	16	12.5	46	22.6	24	20.0	125	21.0	40	17.0
Open-canopy road	49	77.1	3	68.3	30	42.2	24	54.4	79	63.8	27	55.9
More than one type	12	39.2	0	--	5	68.0	1	20.0	17	47.6	1	20.0
Any edge	251	37.1	21	22.4	141	29.5	62	33.0	392	34.4	83	30.3

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Table 8. Means and standard errors (SE) of microhabitat variables surrounding nests of Cerulean Warblers (n=3) in southern West Virginia.

Variables	Mean	SE	Range
Aspect Code	0.9	0.5	0.5-1.8
Slope (%)	47.3	1.9	45-51
Distance to closest edge (m)	20.0	10.4	5-40
Nest Height (m)	15.8	3.3	9-20
Stem Density (no./ha)			
<2.5 cm	6916.7	2387.4	2625-10875
>2.5-8 cm	541.7	150.2	250-750
>8-23 cm	408.3	93.9	250-575
>23-38 cm	141.7	65.1	25-250
>38 cm	116.7	104.4	0-325
Snags >8 cm	241.7	41.7	200-325
Canopy Cover (%)			
>0.5-3 m	13.3	7.3	0-25
>3-6 m	25.0	11.5	5-45
>6-12 m	31.7	16.4	0-55
>12-18 m	36.7	18.6	0-60
>18-24 m	45.0	13.2	25-70
>24 m	30.0	16.1	5-60

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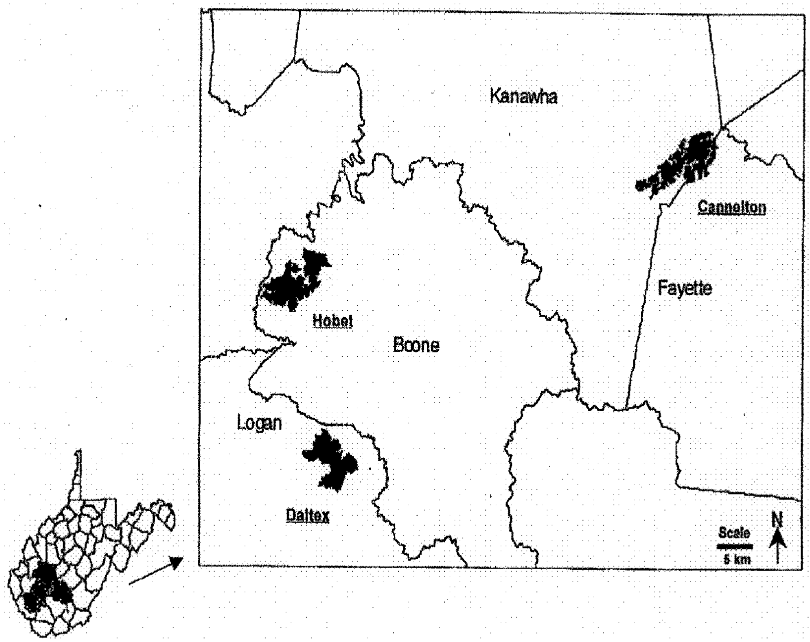

Figure 1. Location of the Hobet, Daltex, and Cannelton mountaintop mine complexes in southern West Virginia.

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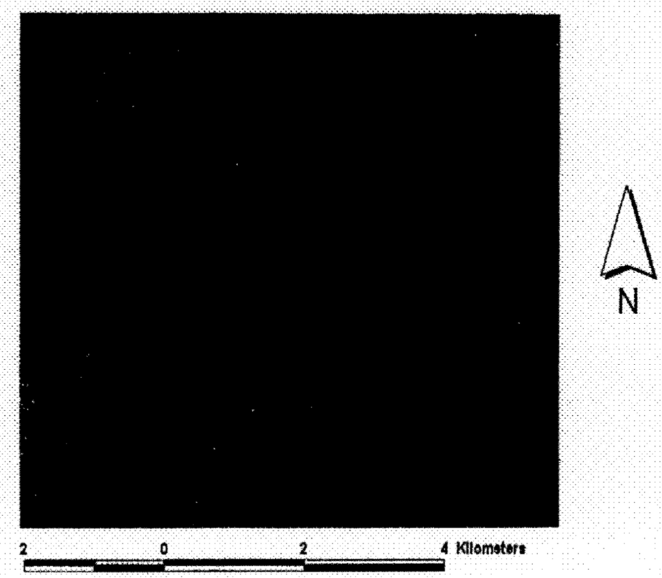

Figure 2. Aerial photo showing the location of study plots on and near the Cannelton mine complex. Plot boundaries are in red.

30

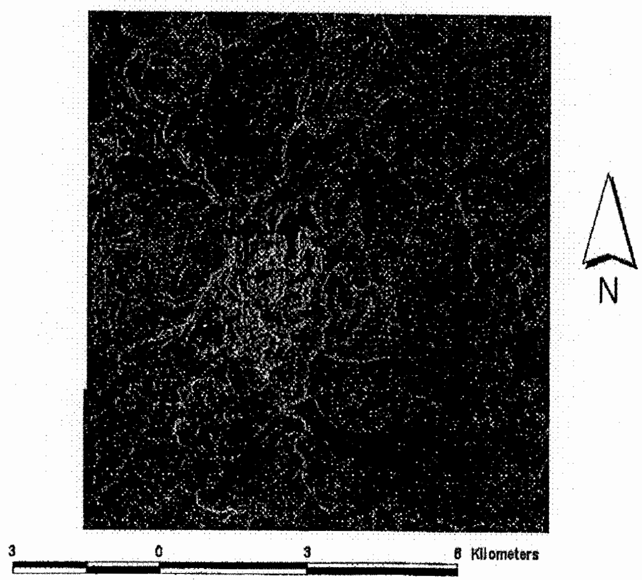

Figure 3. Aerial photo showing the location of study plots on and near the Daltex mine complex. Plot boundaries are in red.

31

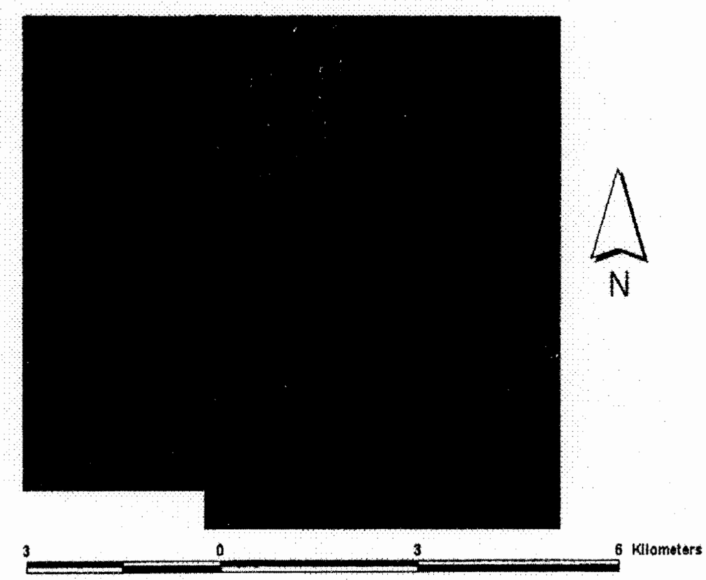

Figure 4. Aerial photo showing the location of study plots on and near the Hobet mine complex. Plot boundaries are in red.

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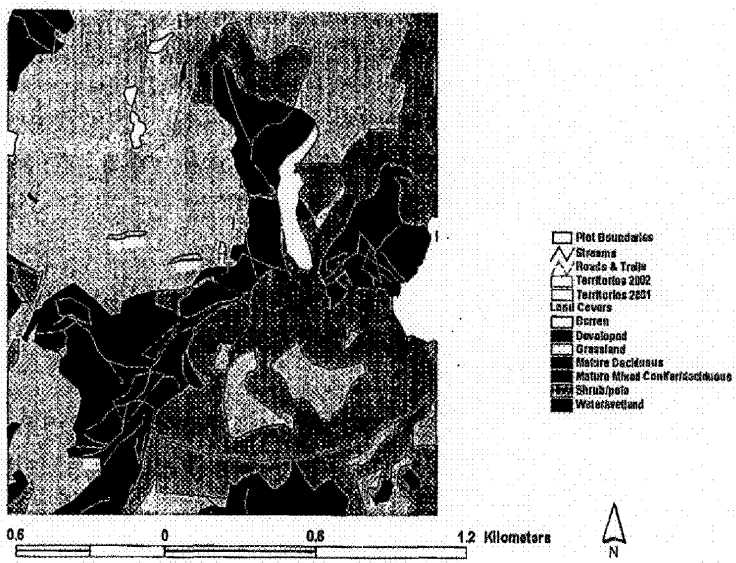

Figure 5. Fragmented forest plots and Cerulean Warbler territories in 2001 and 2002 at the Cannelton Mine.

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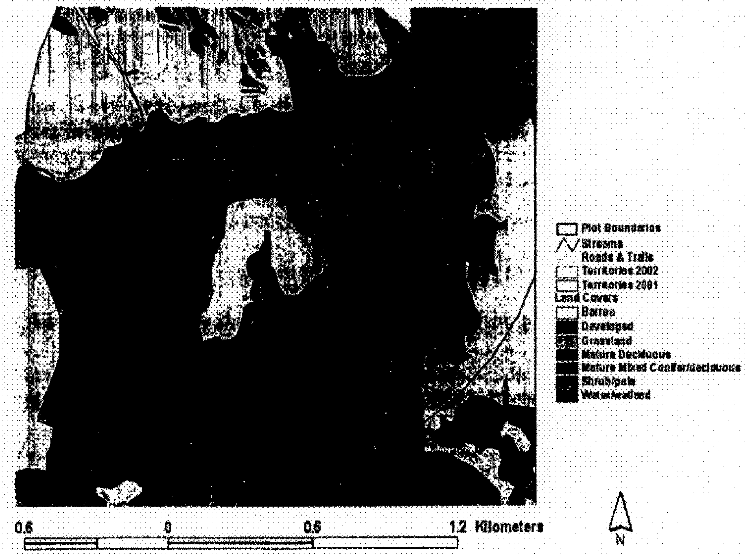

Figure 6. Fragmented forest plots and Cerulean Warbler territories in 2001 and 2002 at the Cannelton Mine.

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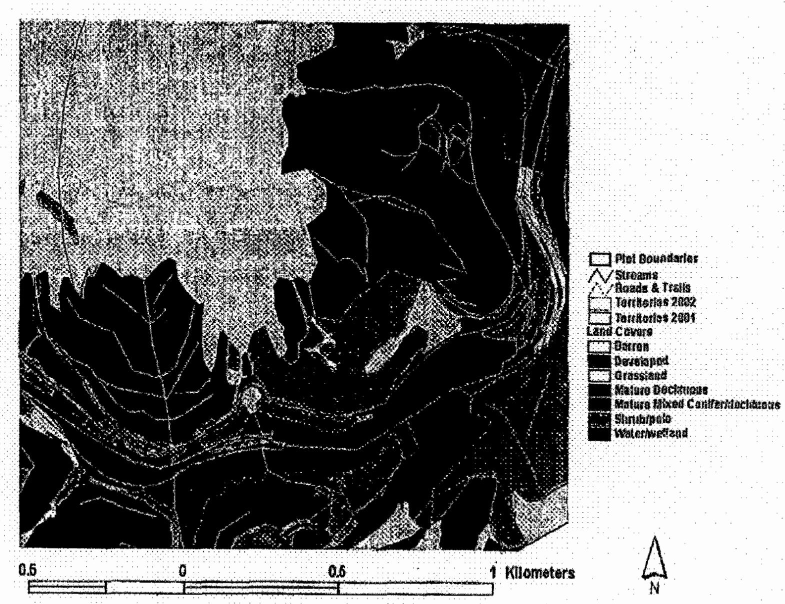

Figure 7. Fragmented forest plots and Cerulean Warbler territories in 2001 and 2002 at the Daltex Mine.

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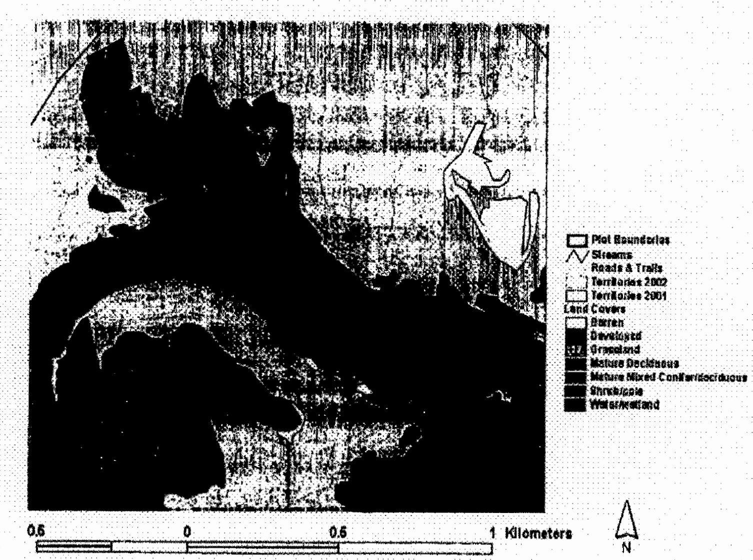

Figure 8. Fragmented forest plots and Cerulean Warbler territories in 2001 and 2002 at the Daltex Mine.

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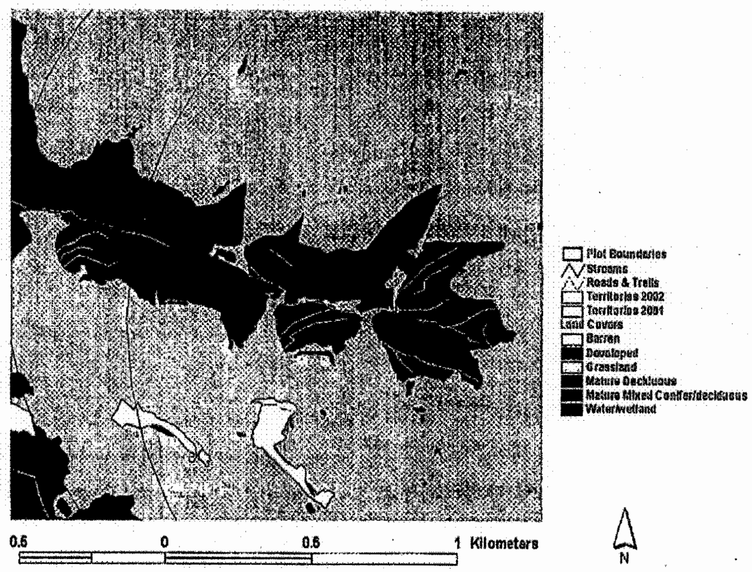

Figure 9. Fragmented forest plots and Cerulean Warbler territories in 2001 and 2002 at the Hobet Mine.

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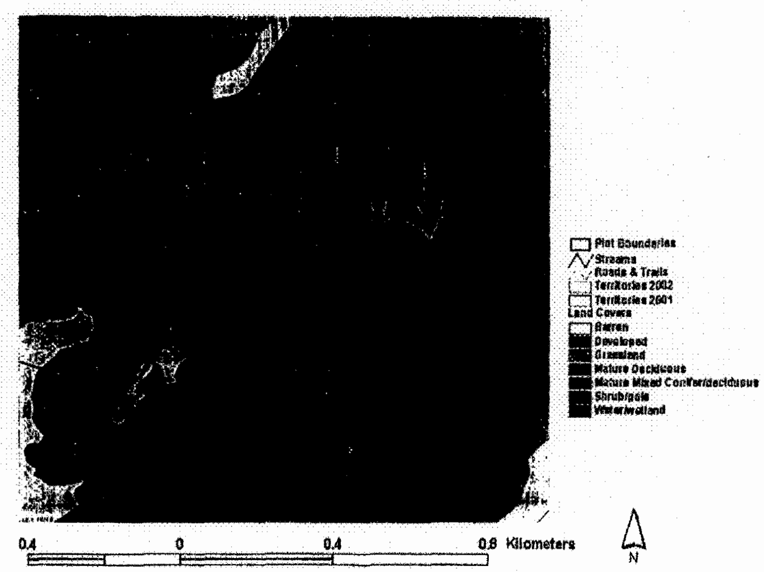

Figure 10. Fragmented forest plots and Cerulean Warbler territories in 2001 and 2002 at the Hobet Mine.

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